CIVIL ENGINEERING

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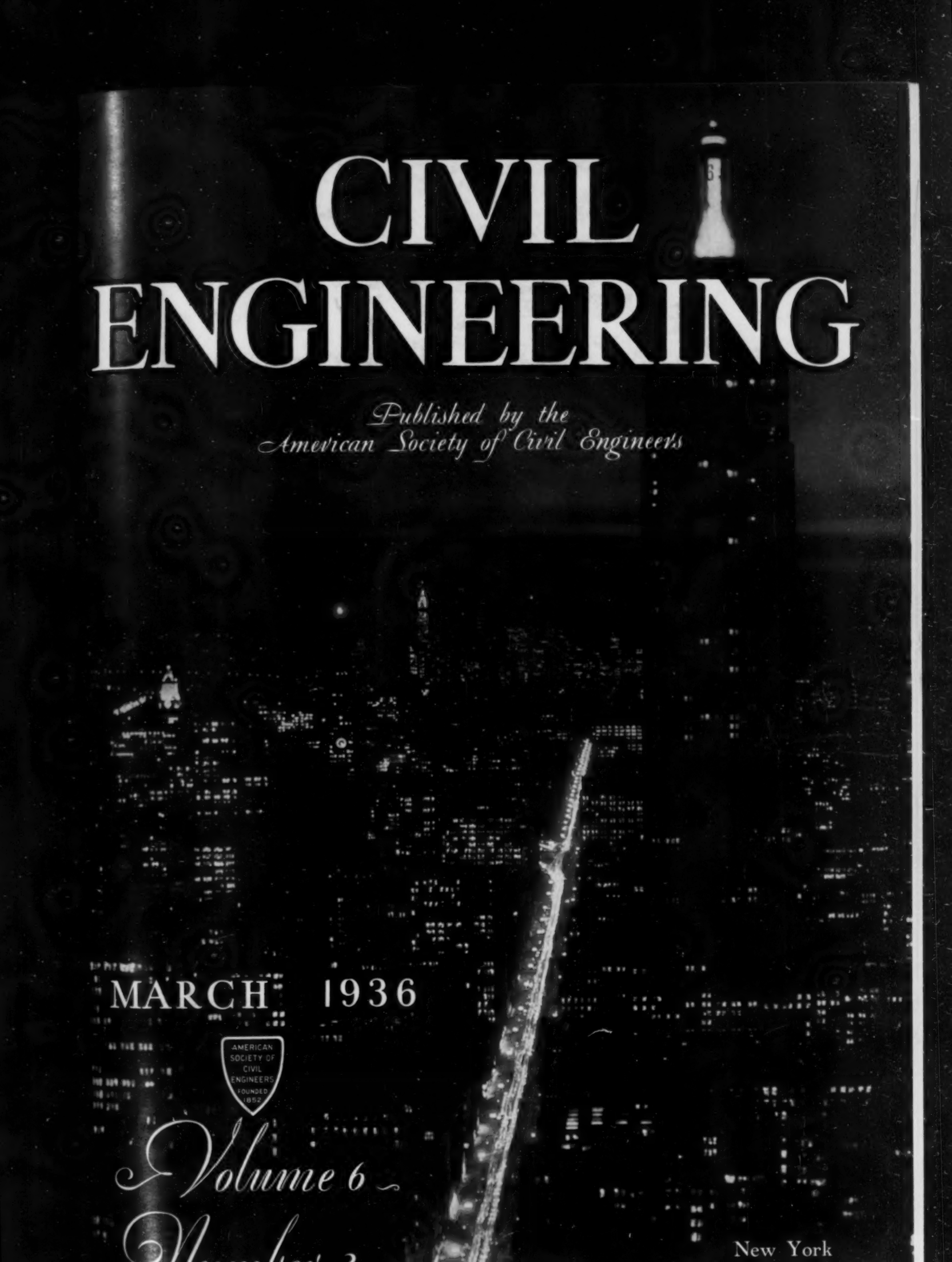

MARCH 1936

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 6

Number 3

New York

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Among Our Writers

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Advances in Construction Practice

New Equipment and Improved Methods Make Possible Increasingly Greater Undertakings

ADVANCES in construction equipment and methods in recent years have made economically possible such huge projects as those being carried forward by the Bureau of Reclamation, the Tennessee Valley Authority, the U. S. Corps of Engineers, the Metropolitan Water District of Southern California, and other organizations. Twenty years ago undertakings of this size would not have been feasible. The principal features of these advances were discussed on January 16, 1936, in five papers delivered before the Construction Division at the Annual Meeting of the Society. An abstract of each of the addresses appears herewith for the information of members.

In the introductory paper, Mr. Ackerman asks whether it is reasonable for an engineer to plan for and attempt to produce a great work without considering the limitations of construction equipment and methods, and, where possible and desirable, developing special ones. By studying ways and means and assuming such slight additional responsibility as is entailed in most instances, a better job is insured. Better equipment and methods, brought about through greater coordination of the functions of engineering, construction, and equipment manufacturing, cannot fail to reduce costs. In this coordination the engineer should take the initiative.

Owing to increased activity in dam and levee construction work, the development of earth-moving equipment, as described by Mr. Knappen, has led the field. Electrically powered cableways and large draglines on the one hand, and elevating graders and the various haul units on the other, supplement and at times compete with one another. The future trend seems to be toward complete mechanization of haul units, abandonment of the industrial railway in favor of the truck or its equivalent, and gradual substitution of Diesel power for gasoline.

Equipment for handling concrete has made great advances, as will appear in Mr. Gardiner's article. The use of vibrators makes it possible to place a much dryer and harsher concrete than formerly. The pumping of concrete is an important development, being most advantageous where large volumes of concrete are placed within rather restricted areas. Where the distance between aggregate plant and site is considerable or where it varies over a wide range, the agitating truck and the mixer truck are indispensable.

In the last decade, welding also has made great strides, as Mr. Spraragen shows in the fourth paper of the symposium. Better designs for connections and better materials and methods have been developed. Welding has been used with advantage in fabricating pipe as large as 30 ft in diameter, and in erecting large steel-framed buildings subjected to unusual wind and earthquake stresses. In making repairs to steelwork already fabricated, its advantages are evident. A much wider use of welding in the future may safely be predicted.

In Mr. Fine's article it is pointed out that recent advances in the field of structural steel erection represent improvements in existing methods and equipment rather than the development of new ones. Increased mobility of cranes and improvement of trucks and trailers have facilitated operations. The modern two-stage air compressor and an improved type of bolt-tightening machine have been developed. The introduction of steel falsework bents has extended the use of the cantilever method in the erection of long-span bridges, and improvements along other related lines have taken place or are under way.

The Engineer and the Construction Plant

By ADOLPH J. ACKERMAN
ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSTRUCTION PLANT ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

ONE need only to review the present procedure for handling a large construction project to appreciate the opportunities which the engineer has for facilitating advances in the construction field. Generally engineers begin by setting up plans and specifications for a new project which, of course, is felt to be physically possible and economically sound. As a rule the specifications give a time limit for completion of the project; fix certain limits on hours of employment and wages; and state very definitely how concrete must be mixed and placed, what limitations must be observed in preparing aggregates, in excavating, in disposing of excavated materials, in blasting and removing rock, and in depositing materials (in the case of earth dams and similar structures).

In most cases the bidder has only a general conception

of how to proceed with the work should he be awarded the contract. He prepares his bid on the basis of methods and unit costs developed from previous experience on similar work. Every element of uncertainty is thrown into his lap, and competitive conditions generally permit him to plan only for the minimum of housing and living conditions for those employees who must live on the job. In bidding, any unusual requirements of the specifications are frequently passed over with the expectation that the equipment manufacturers will come to the rescue.

When the award has been made, the equipment salesmen do besiege the contractor. Some new and untried device or method may be proposed which on paper should cut his cost in half, but where such claims are colored by the prospects of landing a rich commission, the unwary contractor may gain some important but unhappy experience. This, in the end, reflects on the manufacturer and may ruin whatever good ideas might have been developed if the device had been limited to its proper sphere. On other jobs the contractor may shop for second-hand equipment wherever possible, or adapt his own equipment from other jobs, thereby parting with the least amount of money; or he may buy new equipment, driving hard bargins and making demands for special discounts or deferred payments. These handicap the manufacturers and usually result in a cheaper standard of construction. Bronze bearings, for example, may be used where high-grade roller bearings would add vastly to the life and performance of the equipment, and cheaper metals may be employed where special alloys would pay for themselves many times over. In the end, the manufacturer is in business to make a profit and the purchaser will not receive any more than he pays for. Where manufacturers deliberately handicap themselves by offering special inducements they generally contribute very little to the construction art.

GENERAL VIEW OF NORRIS DAM

The Cableways Span the Dam from Side to Side, Making Concrete Placement Possible at Every Point

When the job finally gets under way it is frequently found that the contractor's equipment has certain natural limitations which were not allowed for when the specifications were prepared, and immediately there is a difference of opinion between engineer and contractor. At other times the specifications have limited the contractor's procedure in a way which turns out to be unnecessary and yet must be adhered to, thereby causing wasteful expense. Or again, the operations may disclose that certain modifications in equipment or procedure will result in a much better job than had been thought possible. But where specifications are regarded as gospel law, the experience which might be gained from following up such opportunities is lost.

ENGINEERS SHOULD STUDY CONSTRUCTION METHODS

Advances made in the art of construction and in reducing costs depend largely upon the development of better construction equipment, and this in turn depends upon cooperation between engineer, constructor, and equipment manufacturer. Such advances will receive their greatest acceleration if the engineer takes the initiative by having at all times a thorough understanding of the limitations of construction equipment, by looking for ways to improve construction methods, and by assuming full responsibility for the adaptation of such methods to his prospective undertaking.

The construction industry is moving in the direction of greater mechanization. This principle I believe to be

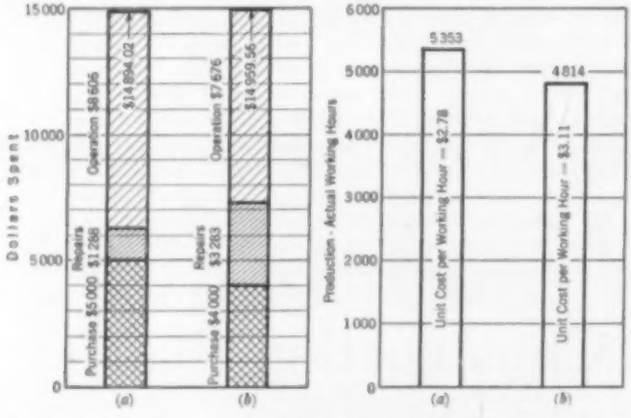


FIG. 1. A COMPARISON OF FIRST COSTS, OPERATING COSTS, AND OUTPUT FOR TWO TRACTORS AFTER ONE YEAR'S OPERATION

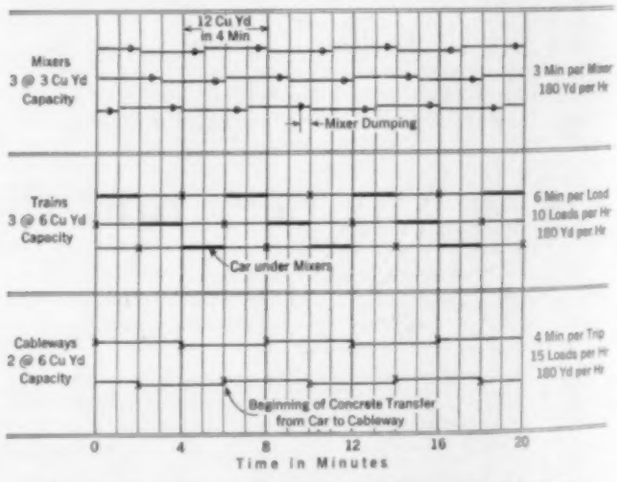


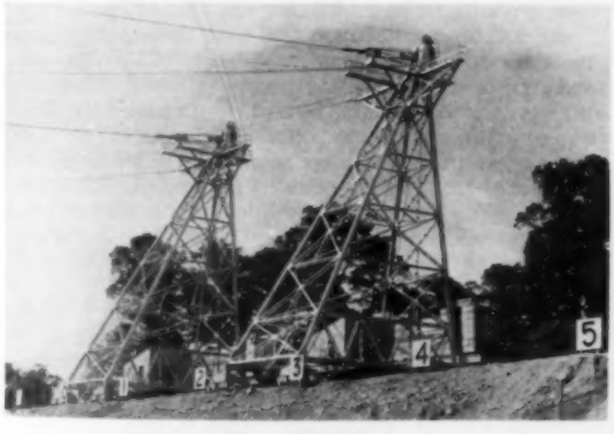
FIG. 2. TIME CYCLE STUDY FOR THE CONCRETE PLANT AT NORRIS DAM

Plant Consists of 3 Mixers, 3 Transfer Cars, and 2 Cableways

fundamentally sound from an employment standpoint, which in these times is of vital concern. Greater mechanization will eliminate certain classes of labor but will result in increased wages for the equipment operators. The housing and sanitary conditions of employees engaged on projects in remote localities will improve as the demand for such facilities is reduced. In the end all this will result in lower costs. The construction industry can best contribute to the permanent stability of employment and national economy not by arbitrarily creating a number of temporary jobs, but by reducing costs to a point where a greater number of important structures can be erected which will give new opportunities to the inhabitants of the region.

SPECIAL TYPE OF TRANSFER CAR AND LOCOMOTIVE DEVELOPED AT NORRIS DAM

In the past there have been some remarkable examples of engineering vision and practical understanding of construction procedure among engineers. As this quality becomes more common there will be less tendency to depend upon the contractors. A few of the immediate needs in the planning of a new project follow.



VIEW OF HEAVY-DUTY CABLEWAYS AT NORRIS DAM

On isolated projects housing and sanitation should be fully planned and specified as part of the project so that all contractors can bid on the same basis and employees can be assured of a better standard of living. The engineer should contribute to planning for the welfare of the workers, their families, and the surrounding communities in so far as these are affected by the opening of the project, just as he has planned for the economic balance of the region in terms of the completed project. As previously stated, the engineer should maintain at all times a thorough understanding of the capability and limitations of construction equipment. Where unit price bids are involved, he can make substantial improvements by including items for camps, access roads, storage areas, construction plants, and other essential features of the project, on which payments may be made promptly as such work is performed; if such items are included the contractor is less likely to unbalance his bid and there will thus be eliminated a potential abuse to which the engineer frequently points a critical finger but in which he has a large share of responsibility.

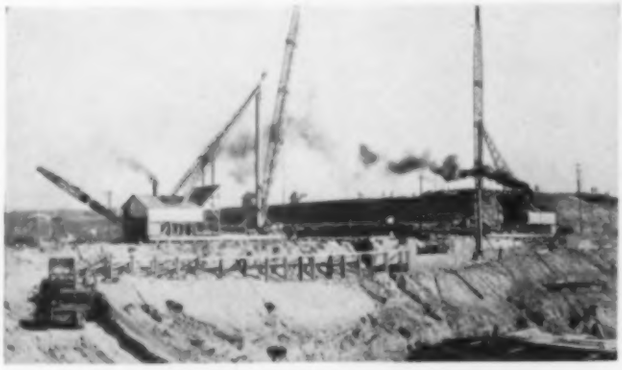
Indications are plentiful that the engineering profession has not adequately explored its opportunities for supplying technically trained and practical men to the construction industry. The frequent lack of courses in construction engineering in the engineering curricula of our universities is an illustration. In the meantime new construction equipment and methods are constantly being developed, increasing the demand for technically trained personnel who can serve contractors and constructors in planning the more complex construction operations. It is becoming increasingly difficult to make the correct selection for a particular job without carefully analyzing the nature of the work and the suitability of the equipment. The possibilities for employing modern special alloys and light-weight metals, making advances in the art of welding, and perfecting improvements in small tools, are becoming so complex that the construction superintendent must depend more and more on technical advice.

PLANNING A LARGE CONSTRUCTION LAYOUT

An elementary principle of equipment selection is illustrated in Fig. 1, which compares operating costs for two tractors employed on the same kind of work. One, costing $5,000, was designed for heavy duty, and the other, which cost $4,000, was designed for lighter duty. During a period of 12 months, the heavy-duty tractor underwent comparatively few repairs, and because of less outage time turned out more work than the lighter one. At the end of 12 months, the lighter tractor had operated 500 hours less time, resulting in a loss in dollars amounting to more than the difference in the first cost of the tractors. Furthermore, whenever this unit was out of service the entire operation of which it was a part was handicapped, and the loss was actually much greater.

The foregoing principle applies with equal force to a construction plant costing a million dollars. The important point to consider is the overall cost at the end of

the job, and the necessary planning in the case of a large project involves high-grade engineering of the first order. The selection of the best procedure is a matter for scientific analysis, and is not merely a matter of giving the superintendent a free hand in satisfying his whims, temperament, or habit. Nor is the modern superintendent willing to proceed without such technical analysis. On large projects with a heavy investment of construction plant, an error in selection of equipment or method is very serious, being second only, as a rule, to the costs involved in making a change after the work is once under way. On construction planning, first cost of plant plus operating cost plus incidental cost should equal a minimum. In some cases, the "incidental" cost in reality may be a major controlling element, as in the case of the cost of river handling and cofferdams in dam construction. Where increasing the first cost of plant will result in a reduction in cost of the other two items, the lowest total cost of the project may thus be secured.



Derricks on Land, with High Booms for Handling Sheet Piling

Derricks on Barges, Constructing a Cellular Sheet-Pile Cofferdam

SPECIAL TYPE OF GUY SKID DERRICK ADAPTED FOR USE AT NORRIS DAM

On the large construction projects of the Tennessee Valley Authority, special opportunities have been provided for coordinating engineering and construction problems and for working out equipment problems with the manufacturers. The successful results achieved are largely due to the influence of Charles H. Locher, M. Am. Soc. C.E., who as construction consultant served to coordinate these various interests.

PREPARING TIME STUDIES AND CHARTS

In making the plant layout for Norris Dam, the first step was the development of a skeleton plan showing the location of the most important features. Then line diagrams were prepared in the course of a detailed study of the capacity of various types of equipment and their relationships, together with the development of essential points for controlling operation and for introducing flexibility to meet the large number of varying conditions. This was followed by the preparation of time studies to establish balanced and economical cycles of operation of individual pieces of equipment in relationship to other parts of the plant, to which they had to be properly coordinated. A sample of such a time-cycle study is shown in Fig. 2. By this method, the correct number and capacities of the different types of equipment were determined.

Finally, detailed operating charts were prepared. On the chart for the mixer plant, for example, all essential features were laid out and the entire system of levers and signals developed, described, related to the necessary operating personnel, and converted directly into instructions for each member of the operating staff. With each man following his instructions, the entire plant was placed in operation without much trouble. Similar charts of operation were worked out in advance for other procedures, as for example the movement of concrete transfer cars and cableways. In the latter case, various exceptional cases of operation which could be reasonably expected from time to time were carefully studied. From such studies charts were developed with operating rules for the guidance of the construction personnel.

The concrete aggregate batchers in the mixer plant at Norris Dam were developed in cooperation with the manufacturer after the most efficient method of operation had been determined. This is a good example of manufacturing equipment to fit the requirements of the job, rather than making the job fit standardized equipment which may not be the most suitable for special cases such as this. The transfer car and locomotive shown in one of the photographs is another example of special equipment developed in cooperation with the manufacturer to meet the special requirements of the job. While standard equipment might have accomplished the same work, the greater efficiency obtained through the special equipment justified the extra expense and developed a substantial profit. By coordinating the manufacture of locomotives, electrical equipment, and transfer cars, it was possible to use a gasoline-electric locomotive for hauling the car into place and then to switch the power over to the transfer car to dump the concrete skips.

SPECIAL HEAVY-DUTY CABLEWAYS DEVELOPED

The cableways shown in one of the photographs were in most respects of a special design particularly suited to heavy-duty service. On account of the investment involved in this part of the plant, it was of greatest importance to operate such equipment at its maximum capacity as much as possible. Accordingly, the cableway equipment was not used to handle forms or for other small operations for which smaller equipment could be employed. For example, a small traveling crane was transported by cableway and placed on top of a completed section of the dam to set up the forms, leaving the cableway available thereafter for heavy-duty operations.

In the photograph showing a general view of Norris Dam, the cableways may be seen spanning the stream from side to side. This arrangement made concrete placement possible at every point on the dam, irrespective of river stages or diversion of the river from side to side; there was nearly always a place open for further concreting, so that the crushing, screening, mixing, and placing plants could be run at their best rate for most of the time. Where it is necessary to divide the work into

sections and build each in stages before it is possible to proceed to the next, such a procedure may prevent the mixing and placing plants from producing at their maximum rate. In such case, it is impossible to produce at the lowest unit cost.

Two of the photographs illustrate an interesting example of how proper construction planning sometimes develops special types of equipment not ordinarily available. Here the problem of handling long sheet piling called for the use of special derricks with extra-long booms. A combination guy and stiff-leg derrick was selected. In one photograph these derricks are shown on land, driving a sheet-pile cut-off wall. While this type of derrick is not stable laterally, its narrow base makes it easier to skid along, and as shown in the companion photograph it can be readily mounted on a barge and used for building a cellular cofferdam where the high lift is particularly essential. Pulling the piling in the cofferdam is another type of operation for which this type of equipment is well suited because of its greater stability. This type of derrick, developed originally for the Bagnell Dam project in Missouri, has found satisfactory application on a number of projects where it was demanded by the constructor, yet there has been little disposition to offer it as standard equipment by the manufacturers.

Among the more important considerations in the operation of large construction plants are matters of efficiency, output, freedom from breakdowns, and elimination of recurrent repairs. In this field, engineers, with their technical and analytical ability, can study operations in the same detail that is applied in large manufacturing operations where high production and efficiency are taken for granted. The use of graphical recorders and special meters on all major equipment will lead to surprising discoveries of inefficiency, mechanical defects, inadequate maintenance and repairs, and shortcomings in the operating personnel. If such records are analyzed by technically trained men, important improvements will be obtained. By plotting the records on charts readily understandable to the operators, a healthy competition for better performance can be developed between shifts. Many contractors recognize the need for such technical services but contend that the number of engineers with a thoroughly practical viewpoint and sound judgment in this field is very limited.

At present the engineer is generally thought of as a man who conceives a great project and sees to it that the desired results are obtained. Why leave the problem of calculating how to do the job to the contractor and the equipment salesman? Does not the engineer's responsibility and opportunity for greater service lie in helping to make construction a science rather than a gamble?

Development of Earth-Moving Equipment

By THEODORE T. KNAPPEN
ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CHIEF, ENGINEERING DIVISION, U. S. ENGINEER OFFICE, ZANESVILLE, OHIO

THE history of earth-moving is as old as civilization. When the wheelbarrow was first used for transporting earth, a marked advance had been made, and the unsung genius who first dumped his wagon load of dirt by turning a loose board in the bed of the wagon contributed economically to many generations of earth-movers. Modern earth-moving received its greatest impetus when the first steam shovel was used for excavating railroad cuts, and when Page developed his dragline on the Hennepin Canal. The subsequent advances in the design and manufacture of equipment have resulted from the demands for improved arteries of transportation—railways, highways, and waterways—and for greater protection from nature, in the form of levees to protect against floods and drainage ditches to remove excess water.

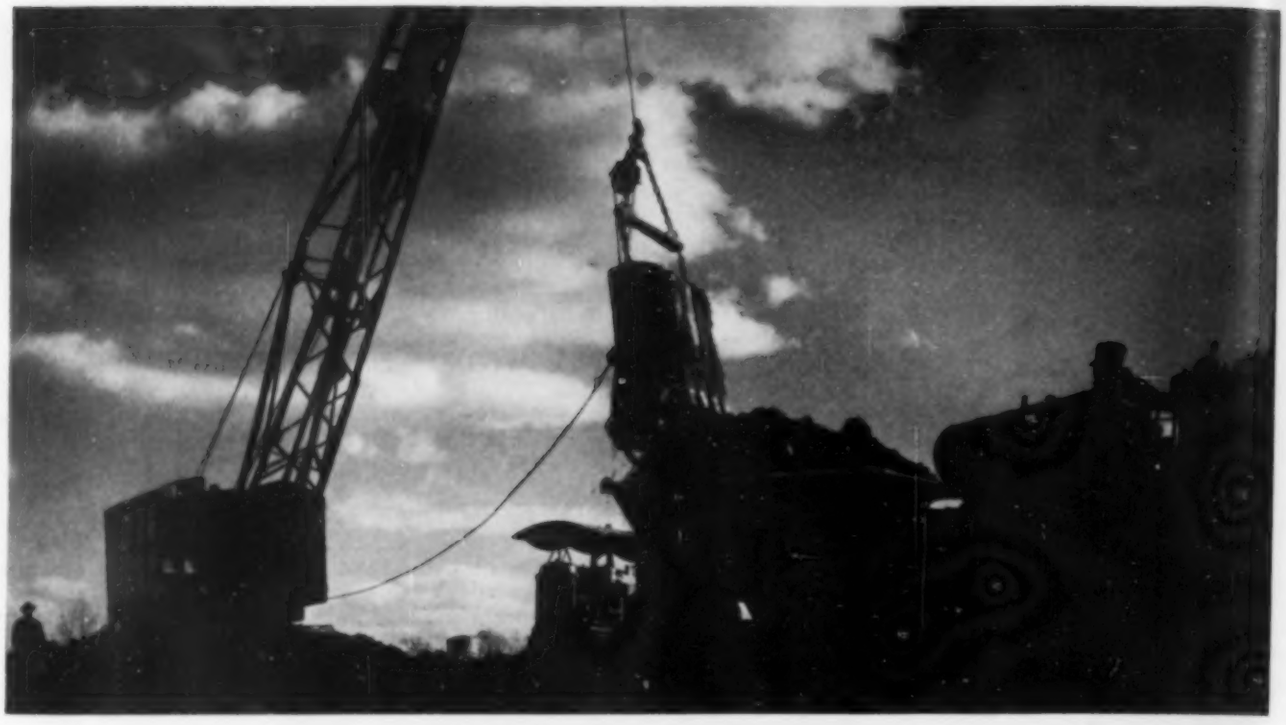
The nineteenth century was marked in this country by a period of canal building, followed by tremendous railroad expansion. The Panama Canal construction ushered in the twentieth century era of great earth-moving projects. The mule and cart and the slip scraper, followed toward the close of the period by the steam shovel and the narrow-gage railroad, built our railroads. Our levees and drainage systems, as they existed a few years ago, were built to a large extent by the mule team and the bottom-dump wagon, assisted by the wheel scraper, the slip, the fresno, and in later years by the dragline and the tower excavator. Considerable advance was made in using the early type of equipment at the time the elevating grader was developed for loading wagons. However, the capacity of these early machines was limited by the number of mule teams which could be hitched up to supply power for the cutting blade and the elevating belt. The tractor soon supplanted mules for hauling the elevating grader. Use of the steam shovel was an important matter in Panama Canal construction.

Early drainage ditches were excavated by the wheel scraper, the slip scraper, and to some extent the elevating grader, supplemented by the hand shovel. Increasing demands for deeper and wider ditches brought the floating dipper dredge into general use, and it was employed to construct thousands of miles of ditches up to the middle 1920's. About that time, however, the dragline, with its steadily increasing efficiency, supplanted the dipper dredge. Today, the use of the dipper dredge for drainage purposes is practically unknown.

With the advent of the automobile early in the twentieth century, a demand for improved roads developed. The response to this demand first took the form of improved surfacing, but by the middle of the 1920's the alignment of roads was beginning to be improved. This increased the quantity of earth excavation and the length of haul. The old use of mule teams and industrial railroads persisted for long-haul work, but these were soon supplemented by the dump truck powered by gasoline engine. The dragline was employed to build highway fills across bottom lands and roads benched into side hills, while the elevating grader was used for road construction across the flat prairies, along with the familiar wheel scraper, slip scraper, and fresno.

HYDRAULIC FILLS AND PIPE-LINE DREDGES

Other methods of earth-moving were in use, scattered throughout the country. Water was a powerful tool for the excavation and transportation of material. The great California placer-field operations of the seventies were made possible by the use of the hydraulic monitor, or giant, which jetted water at tremendous velocities



NIGHT FALLS ON DRAGLINE EXCAVATION

against the gravel banks to cut them down and wash them through the sluice boxes, where the heavy gold was trapped. When the California state legislature barred the use of the hydraulic monitor on the headwaters of streams flowing into the central valleys, the ingenious operators developed the ladder dredge for working the placer fields suited to it.

The hydraulic pipe-line dredge with its cutter-head

THE HORSE-DRAWN FRESNO SCRAPER, AN EARLY FORM OF EQUIPMENT MANNED BY EARLY AMERICANS

Supplanted by More Modern Equipment in Middle and Late 1920's

excavator, or suction head, was developed for the excavation of harbors and for gravel digging. In the early days built land was a by-product of its operations but in later years became one of its main functions. Many city waterfronts were built up in this way, and in the Florida boom, hundreds of these dredges made land grow where before there had been only tidal wastes.

As an offshoot of the methods developed for placer mining, came the hydraulic-fill dam, in which materials were washed from the hillsides and sluiced across the river channels. In some cases, the hydraulic method was used only for placing material which was hauled to hog boxes by means of rail facilities, as in the Miami District in the period 1916–1920, and as a means of placement and segregation in the semi-hydraulic dams of recent years. The pipe-line dredge, too, was adopted for the construction of hydraulic-fill dams.

During the middle and late 1920's, as the great business boom in this country was drawing to a close, the railroad-mounted steam shovel of early days was being placed on crawlers, and steam power itself was giving way to electrical and gasoline power, and to some extent to Diesel power. The smaller units were built interchangeably as shovels, draglines, or cranes. The air crowd had come in and was being used extensively on shovels. The truck was being slowly developed for use in hauling excavated materials. Power was everywhere being applied.

PNEUMATIC-TIRED STEEL BUGGY OF 25-CU YD CAPACITY

Unloading Is Accomplished by Sliding the Loads Off the Wagon Bed

Old mule wagons were being hauled by tractors; fresnoes and wheel scrapers were hitched up in tandem behind them. Great draglines were being constructed, mounted on caterpillars, with increasing boom lengths and bucket sizes. A new type of dragline, the Monighan, with its grotesque looking but highly efficient walking device, was coming into use. The cableway excavator, brought to perfection during the War, was being used extensively on the Mississippi River for dragging dirt into levees from pits up to 700 ft wide. At the same time the old types of equipment—the mule wagon, wheel scraper, mule-powered fresno, and standard and narrow-gage rail haul units, with the Jordan spreader—continued in use.

The great flood on the Mississippi River in 1927 resulted in the $325,000,000 flood-control bill of 1928, which gave a new impetus to this lagging branch of the construction industry. Also about this time Congress increased the Federal-aid road allotments, and this, with the tremendous revenues from gasoline taxes, injected new life into the highway building program. The demands of the motoring public for straighter, flatter, wider highways were increasingly felt. Beginning in 1930 and 1931, the ever-increasing sums poured by national recovery measures into public works projects for the construction of highways, waterways, levees, and earth dams challenged the engineer and the equipment manufacturer to handle economically vast quantities of earthy materials.

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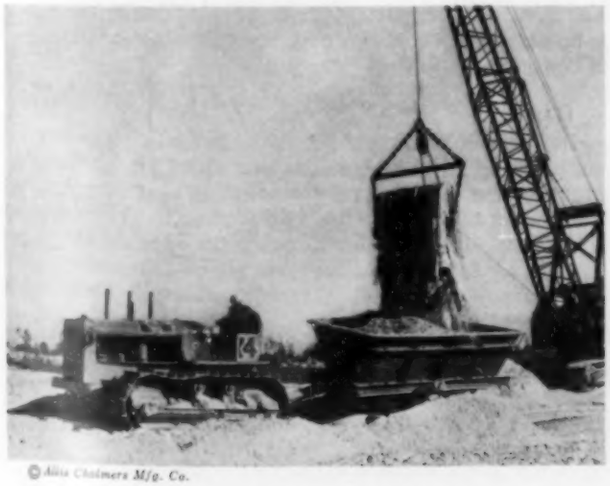
LARGE WHEELED TRACTORS DRAWING HEAVY LOADS CONSTITUTE A RECENT DEVELOPMENT

MODERN EQUIPMENT FOR LEVEE CONSTRUCTION

Today in the levee-building and canal-excavating fields, where economical methods for moving earth in volume are of great importance, the dragline, tower machine, belt conveyor, and variations of these are in use. The improved cableway, generally electrically operated, is mounted on crawlers with towers extending 120 ft into the air; draglines span borrow pits, reaching as much as a thousand feet from the center line of the levee; and great crescent-shaped buckets haul 15 cu yd of material at a trip. The Monighan dragline handles and rehandles material to place it in the levee, and sidesteps to get the greatest quantity into the levee with one handling. These machines have booms 150-ft long—even 175 ft long in some cases—and buckets holding as much as 7 cu yd. Despite higher levees and longer hauls, the work is being done at ever lower costs.

At the same time efficient tractor units supplement these giants, and in many cases compete with them. The improved elevating grader, which has a separate power-operated belt and powerful Diesel tractors drawing it, is today loading 100,000 to 200,000 cu yd of material a month. On levee work, the shovel often is not used for loading because of the treacherous footing generally encountered in the bottom of the borrow pits. The small dragline is used for loading in special cases, particularly where the ground has been heavily timbered, and is also employed as an auxiliary for ditching, dressing, and excavating exploration trenches. Other means used for levee building include pipe lines, dredges, and the belt conveyors. The power-driven successors to the wheel scrapers have been tried but cannot compete with the dragline except in rare instances. The mule wagon is gone; it is generally too wet for the truck; while the crawler wagon is used only on special jobs.

In the construction of the All-American Canal, the Florida Ship Canal, and other great jobs that are primarily earth-removal projects, we find the great earth-moving machines used to the limit of their ability. On all these it is only when the haul gets up to about 700 ft that the haul units compete with the machines. The trend in the last few years has been toward larger and more flexible units. Diesel power, either direct or through electrical generation, has virtually replaced steam and gasoline. For individual problems there has been a tendency toward individual design of equipment,



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LOADING TRACTOR AND TRACK WAGON BY DRAGLINE

THE MODERN ELEVATING GRADER TAKES POWER DIRECTLY FROM THE TRACTOR

applying the latest advances and varying them to meet conditions. The belt conveyor has been slowly emerging, as its design has been improved and its use better understood, as an important earth-moving unit. With it,

FLOATING DIPPER DREDGES ARE ADAPTED TO ROUGH WORK WHERE THE SPOIL IS PLACED CLOSE TO THE CHANNEL

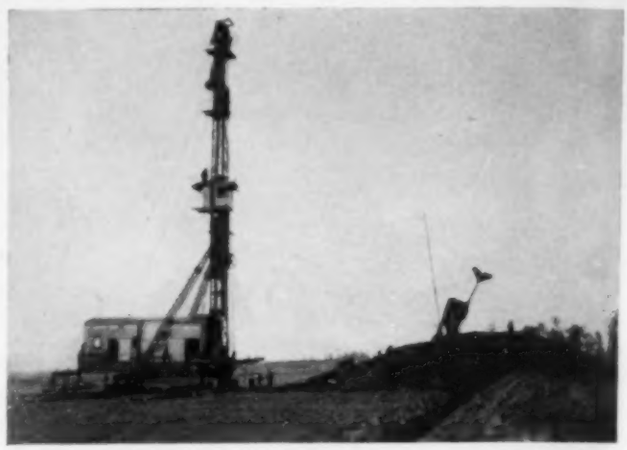
the dragline is the favored tool for loading, although the shovel may be used.

Looking into the immediate future—for it would be rash to attempt a long-range prediction—the improved, lightened, and possibly slightly enlarged dragline will be supreme where the movement is up to 500 ft, with the tower excavator, the belt conveyor, and other conveyor types close behind. For longer hauls, the tower excavator, the conveyor types, and the haul units will be used; for straight going, the tower; for larger movements, the conveyor; and for irregular jobs, the haul units. Under average conditions, a 150-ft boom dragline can excavate and place for 10 cents per cu yd on a 300-ft maximum movement; if the haul is 500 ft, the cost is 14 cents. As for the haul unit, it costs about 6 cents to excavate and 4 cents to place, or a total of 10 cents; and about $^3/_4$ cent per station yard to haul, or 12 cents at 300 ft and 14 cents at 500 ft. With the belt conveyor, it costs a little more to excavate and place but less to haul, and when the going is hard, the cost of hauling goes up for the haul unit. Every job is a problem in itself, and the operators of the various types of equipment fight it out when the bids are opened.

For many years the dipper dredge flourished in the drainage field, but today it has been supplanted by the dragline. The ditch excavated by the dipper dredge was uneven in section and had circular side slopes, which were prone to cave or slough. Its limited radius of action and the wet materials of excavation gave little margin for a berm between the spoil bank and the ditch, so that sloughing sides brought the excavated material back into the section. The mechanical improvement of the dragline tended to bring its excavating costs close to those for the dipper dredge, and its greater flexibility permitted flatter slopes and wider berms. So today the dragline has the drainage field almost to itself.

DEVELOPMENT OF SOIL MECHANICS SHOWS IMPORTANCE OF CONSOLIDATING EMBANKMENTS

In the first thirty years of the twentieth century tremendous technical advances were made in almost every line of construction except the technical side of embankment and earth-dam construction. Very little was known about earth structures. Contributions to this subject had been made since the turn of the century by Stearns, Saville, Hazen, and others in the PROCEEDINGS of the Society and in scattered articles appearing in other publications. It remained for Terzaghi and other investigators in the middle 1920's to initiate the formal development of the science of soil mechanics. The use and development of the soil mechanics laboratory has given new confidence to the designers of earth dams and embankments. About 1908 the sheepsfoot roller was developed and applied to the construction of earth dams in the West, but the plain or banded roller was largely retained in the East until recent years. In 1931, R. R. Proctor, Assoc. M. Am. Soc. C.E. published in *Engineering News-Record* the results of studies on the effect of rolling and of water content in rolled embankments.



TOWER EXCAVATOR, SHOWING HEAD TOWER MOUNTED ON WHEELED TRUCK

In the highway field, today's traffic demands are such that all embankments must be consolidated during construction; in other words, the materials must be placed in thin layers, moistened, and rolled. These requirements have made new demands on earth-moving equipment, which has resulted in the recent remarkable development in this field. In the early days of highway building, the dragline was extensively used in constructing fills from adjacent borrow pits. Two factors have today virtually eliminated this use of the dragline—the high cost of maintaining a wearing surface on such fills, and dissatisfaction with the resulting uneven surfaces. At the same time, improvement in short-haul equipment has lowered the cost of consolidated embankments to a point where they compete in cost when maintenance is considered.

EQUIPMENT FOR CONSOLIDATING EMBANKMENTS

In dam-embankment construction, the rolled fill is supplanting the hydraulic fill, although the world's greatest earth dam, now under construction at Fort Peck, Mont., is being build by hydraulic dredges. The four 28-in. dredges at Fort Peck place 3,000,000 cu yd per month against a pipe-line length of five miles and a maximum lift of 270 ft. Even for railroad construction, the consolidated embankment is taking the place of the dumped fill as railroad engineers realize its great advantage from the standpoint of maintenance. In the Muskingum project, 5,000,000 cu yd of railroad embankment are being placed in a consolidated condition.

The rolled fills for highways, earth dams, and railroad embankments are in a class by themselves, for here the material must be placed in layers, the water content controlled, and the material compacted. For short hauls,

the combined excavating, hauling, and placing unit is the power-driven successor to the wheeled scraper, generally tractor-drawn and mounted on pneumatic tires. Where the haul is longer, improved dump trucks, bottom-dump and side-dump crawler wagons, and trailer-type tractor-drawn pneumatic-tired wagons in all sizes from 3 to 25 cu yd take the field. The best use of the truck is on long hauls; where the going is hard, the tractor and crawler wagon seem best adapted, but recent experience is substituting the pneumatic-tired wagon for the crawler wagon. A new development is the 24-cu yd wagon mounted on 16 large low-pressure tires, which bottom-dumps by shoving the upper part of the body out over the bed. The large low-pressure tires wear well, are easier on the equipment, and support their loads, except under the worst conditions. A further step is the pneumatic-tired tractor-type power unit with the trailer wagon, which has greater speed and less depreciation and therefore can place the material for less, under favorable operating conditions. However, they require solid roads and cannot run on very wet earth surfaces.

Contractors are finding that it pays, where possible, to prepare good hauling roads and use pneumatic-tired equipment. The rolled fills lend themselves to the use of this type of equipment, as their surfaces are densely packed and well drained. Wagons and trucks for rolled work are generally bottom- or end-dump, although the side-dump wagon is used to some extent. Necessary auxiliaries to this equipment are tractor-mounted bull-dozers; tractor-drawn water-ballasted sheepsfoot rollers, generally hitched together with the articulated yoke; and power graders.

For loading, the elevating grader is favored when it can be used, but the power shovel is generally required. In heavy rock cuts the 2-cu yd machine is a favorite. The various tractor-powered wheeled scrapers and fresnoes are used for earth cuts. The power scrapers, of course, load themselves. The elevating grader will load for about 5 cents, and the shovel for 7 cents, but this does not include the waiting time of hauling equipment. The cost of spreading, watering, and rolling is about 7 cents, and the cost of hauling, $^3/_4$ cent per station yard, not including the cost of road maintenance.

The trend in haul units is toward complete mechanization—the mule is gone; the truck or its equivalent has taken the place of the railroad car; and Diesel units are supplanting gas. Pneumatic tires are replacing crawler track, which in turn replaced the steel wheel. Again looking into the future, there probably will be ever-increasing specialization in the small units. Equipment will be more extensively mounted on low-pressure tires, and more attention will be paid to haul roads to permit the use of rubber tires on the tractive units. A wider use will develop for the power scraper on short-haul work, and its radius of use may be extended. Diesel power will take the place of gasoline power on all except the very small units, and may include these in a few years.

TOWER EXCAVATOR, SHOWING TAIL TOWER MOUNTED ON CATERPILLAR TRUCK

With the increased specialization in the use of equipment, there will develop a wide field for the construction consultant in planning the earth-moving equipment set-up for large jobs. At the present time too much overhead is going into high-pressure salesmanship and resultant credit losses. The equipment manufacturers will tend to combine in order to provide a complete line of equipment and will follow with technical services in job planning to eliminate the present credit waste and strengthen their customers' financial position.

Modern Equipment for Handling Concrete

By LION GARDINER

VICE-PRESIDENT, THE JAEGER MACHINE COMPANY, COLUMBUS, OHIO

MANY new developments in the field of construction equipment and methods have taken place during the past five years, particularly with respect to the mixing and placing of concrete. Three very definite advances in this field will be discussed in detail. These are the use of vibrators in placing concrete; the pumping of concrete; and the development of trucks, including those which agitate ready-mixed central-plant concrete while transporting it to the job, and those which mix concrete en route from the storage piles to the job.

As regards mass concrete, technical journals have covered so thoroughly the methods followed in the use of vibration that it is scarcely necessary to describe the progress and results obtained. But the use of vibration in placing pavement slabs is not so widespread. In this connection the U. S. Bureau of Public Roads has conducted two rather complete tests, and further experimental stretches have been laid by the states of Illinois, Michigan, Missouri, Kansas, and Ohio, all confirming the possibility of saving from one-half to one bag of cement per cubic yard of concrete.

Present-day concrete for use in paving slabs is designed to give sufficient workability at a slump of from 2 to $2^1/_2$ in. so that the standard finishing machine can readily spread and compact it to a point where there is a minimum of honeycombing in the bottom of the slab. The addition of vibration to the screed of a finishing machine enables it to place and densify a much harsher concrete than can be placed with a standard machine.

A Harsh Mix with 1-In. Slump Has Just Been Deposited

After the Vibrator Has Passed, Fines Come to the Surface

VIBRATORY FINISHER WITH BULLNOSE SCREED

For example, a vibratory machine working on concrete with a slump of from $^3/_4$ to 1 in. is as effective as a standard finisher where the slump is $2^1/_4$ in., based on resultant density and finish. This permits redesign of the mix by reducing the proportion of sand by absolute volume from between 37 and 39 per cent to between 32 and 34 per cent, and increasing the coarse aggregate proportionally, at the same time keeping the water-cement ratio constant. This produces equivalent strength and greater density with a saving of 10 to 16 per cent in cement. The foregoing is typically illustrated in Table I, which shows approximately relative results. The use of the vibratory finisher thus makes possible the replacement of 1 bag of cement, $5^1/_2$ gal of water, and 2 cu ft of sand with coarse aggregate having an equivalent absolute volume. The actual saving of course depends upon other controlling conditions, but without doubt the economy range lies between 0.6 and 1 bag of cement per cubic yard of concrete.

TABLE I. VIBRATED AND UNVIBRATED CONCRETE

Comparison of Approximate Quantities Required to Make 1 Cu Yd of Concrete

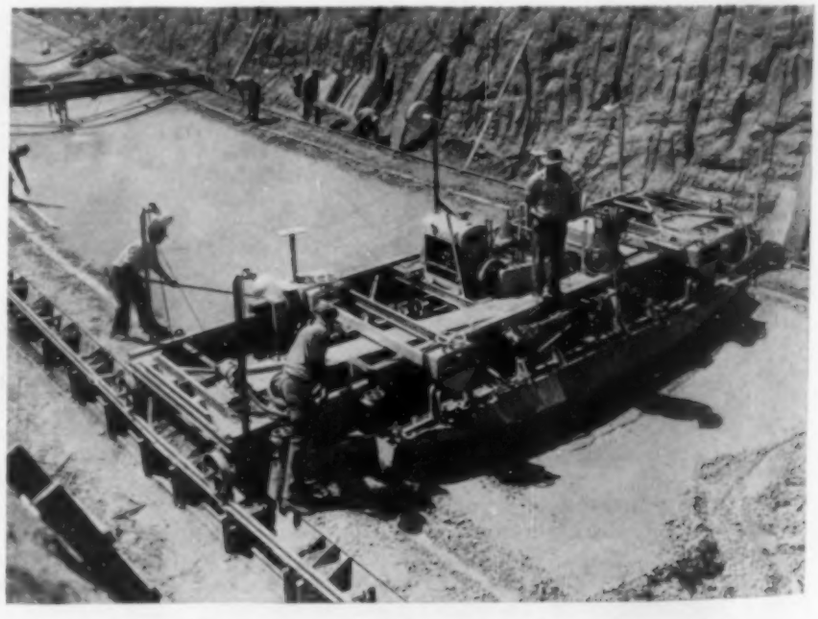
TYPE	CEMENT	WATER	SAND	COARSE AGGREGATE	RESULTING CONCRETE
	Bags	Gal	Cu Ft	Cu Ft	Cu Ft
Vibrated	5	27.5	10.0	22.5	27.0
Unvibrated	6	33.0	12.0	21.0	27.0

Two avenues are thus open to the engineer. He can maintain equivalent strength at a material saving in cement or, by keeping the cement content constant, he can effect an increase in strength of from 15 to 20 per cent. Of course an intermediate course is always available.

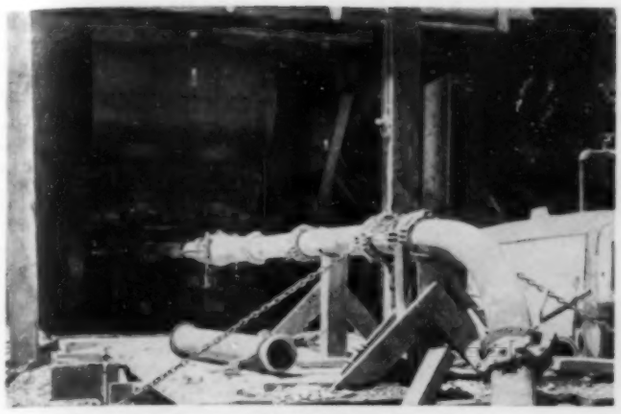
One type of finishing machine used on this type of work has produced the best results through a slight though important modification of the front screed, changing it to the "bullnose" type. This operates from the forms in the conventional manner and the "bullnose" crowds sufficient excess material under the screed to ensure density. The vibratory motors, operating at almost 3,600 rpm, are attached so that the vibration extends not only to the bottom of the screed, but into the front plate as well, thus producing the effect of internal vibration on the mass of concrete which is pushed forward by the screed and made alive by vibratory action. Rubber diaphragms placed in the concrete indicate that this vibratory action is carried forward into the material a distance of 4 to 6 ft. Supporting the screed on the forms ensures dense concrete at the slab edges and does not cause settlement of the forms. The second screed operates in the conventional manner, putting final finish on the pavement. Two vibratory passes are usually sufficient to secure the desired density.

Another type of vibratory finisher applies the vibration through a member or "pan" supported between the two screeds. In this machine, the front screed is slightly raised during the first passage over the concrete so as to provide sufficient material for compaction by the vibratory element. The final finishing is done in the conventional manner.

Other interesting applications of vibration to finish-



VIBRATORY FINISHER IN USE ON CONDUITS BETWEEN BOULDER DAM AND LOS ANGELES



The Twin Pumps Have a Capacity of Over 60 Cu Yd per Hour

10-Ft Sections of Pipe Are Removed as the Work Progresses

CONCRETE PUMPING INSTALLATION AT MILWAUKEE FILTRATION PLANT

ing machines have been made, notably in connection with the use of a 31-ft finishing machine on the lower deck of the San Francisco–Oakland Bay Bridge. The concrete was placed in a mass of reinforcing steel, but the stripping of the forms on the under side of this job gave evidence that the desired result was accomplished.

A vibratory finishing machine was also used on the aqueduct between Boulder Dam and Los Angeles, built under the supervision of the Metropolitan Water District of Southern California. Here the specifications called for an excessively dry harsh mix, with $2^1/_2$-in. aggregate, the invert having a 17-in. negative crown. Without question, the material saving in cement and the

PORTABLE LOADING PLANTS ARE SET UP AT THE NEAREST SIDING
The Transit-Mix Truck Helps Reduce the Amount of Equipment

marked improvement in mass concrete through the application of vibration will soon lead to its general use in slab construction.

DEVELOPMENT OF CONCRETE PUMPS

Except for possible isolated experiments, the first pumping of concrete was accomplished ten years ago by a contractor in Kiel, Germany. His experience with concrete pumps covered a period of four years. Commercial pumping of concrete was first introduced in the United States in the summer of 1932, and about 5,000 cu yd were pumped that year. In 1933 approximately 250,000 cu yd were pumped, and in 1934 and 1935 over a million cu yd was pumped each year.

As yet the only concrete pump that has met with any commercial success in this country is the horizontal piston pump. This pump is equipped with very large inlet and outlet valves, mechanically operated and timed with the piston and crank shaft. Concrete from a supply hopper situated above the cylinder is sucked into the cylinder on the suction stroke and expelled on the pressure stroke in much the same manner as water is handled by an ordinary reciprocating pump. Pump parts that are subject to wear are readily replaceable, but owing to proper choice of materials and heat treatment, these have a surprisingly long life. Because of the unusual characteristics of the material being handled, it is not necessary to close the valves completely, so there is no "nut-cracker" action. No air is used in connection with the pumping action, and the pump cylinder and pipe line are completely filled with concrete. Concrete is delivered from the hopper to the forms in a uniformly mixed condition, free from segregation.

The pipe line is nearly as large in diameter as the pump cylinder, and is made in standard interchangeable sections, with quick-acting toggle couplings and rubber gaskets to prevent leakage. The low velocity of flow makes the pipe wear negligible. At the end of a pour all the concrete in the pipe line is expelled into the forms and the pipe line cleaned by inserting a "go-devil" in the line, just in front of the pump, and forcing it through by water- or air-pressure.

Concrete pumps are now built in single- and double-cylinder models, with capacities ranging from 20 to 65 cu yd per hr. A 50-hp electric motor or 60-hp gasoline engine is used with the largest machine. A general idea of their performance limitations is given in Table II. This table is based on reducing the pumping resistance of any combination of straight pipe, bends, and differences in elevation, to the resistance of an equivalent length of straight horizontal pipe.

A combination of horizontal and vertical distances should be calculated on the basis of 1 ft of vertical pumping equaling 8 ft of horizontal pumping. The total equivalent distance must not exceed the equivalent horizontal pumping distances in the columns of Table II.

Nearly all the concrete mixes commonly used are pumpable, provided they are of a readily workable consistency. Depending somewhat on the harshness of the mixes, concrete as dry as that with a 2-in. slump can be readily pumped, and well-designed mixes can be pumped that are drier than a 1-in. slump, although a slump of from 3 to 6 in. probably gives the best consistency. Concrete of high quality is assured in any case, as a really bad mix cannot be pumped. With well-graded gravel,

1,000 lb of good sand per cubic yard of concrete may be adequate, while with some crushed stone or small-sized gravel for coarse aggregate, 1,300 to 1,400 lb of sand may be required, particularly if there is a deficiency of fines. The cement content may be as low as 4 bags per cu yd, and a large quantity of concrete has been pumped with a cement content of $4^1/_2$ bags per cu yd.

TABLE II. SOME PERTINENT DATA ON CONCRETE PUMP LINES

PUMP SIZE	OUTSIDE DIAM. OF PIPE LINE	MAXIMUM AGGREGATE SIZE, SQ. SCREEN	EQUIV. LENGTH OF STRAIGHT HOR. PIPE*	VERTICAL DISTANCE†
8 in.	8 in.	3 in.	1,000 ft	100 ft
	7 in.	$2^1/_2$ in.	800 ft	100 ft
$7^1/_2$ in.	7 in.	$2^1/_2$ in.	1,000 ft	100 ft
	6 in.	$1^1/_2$ in.	600 ft	100 ft

* A 90-deg bend is assumed as equivalent to 40 ft of horizontal piping, a 45-deg bend as equivalent to 20 ft, and a $22^1/_2$-deg bend as equivalent to 10 ft.
† Not over 200 ft of pipe, actually.

Concrete pumps are being used in a great variety of work, including bridges, viaducts, locks, dams, sewage and filtration plants, marine construction, building construction, and tunnel lining. Within the distance and height limitations given in Table II, the concrete pump system is capable of replacing a series of transporting and elevating devices. In general, this system is convenient and economical for operations where the concrete cannot be readily placed directly from the mixer by spouting or crane. For underground placing and locations that are difficult of access, it has undisputed advantages.

TRUCK MIXERS HAVE RAPID DEVELOPMENT

By 1929 the sale of ready-mixed concrete by material-yards had developed sufficiently to indicate that a new era in the mixing and placing of concrete was in the making. In spite of the depression, manufacturers were bending every effort to improve the mechanical equipment to serve this rapidly increasing industry. No one knows better than the manufacturers of standard concrete building mixers how well the idea has been accepted by contractors and engineers as a means toward better control, economy, and convenience in manufacturing concrete. Rather incomplete and conservative records of the production of this relatively new commodity indicate that from 250 to 300 operators produced 2,600,000 cu yd in 1933, 3,200,000 in 1934, and 3,400,000 in 1935. These figures do not include the rather considerable yardage produced by contractors owning truck mixers. In any event, the data are such as to give every evidence that this operation has come to stay and to form a very definite part in concrete mixing and placing activities. Projects on which ready-mixed concrete has been used in the past year range from the Boulder Dam, the Los Angeles Aqueduct, New York subways, and important railroad projects, to general building construction and paving work.

Generally speaking, ready-mixed concrete is produced in two ways. The first is in central mixing plants discharging mixed or partially mixed concrete into suitably designed agitators capable of improving its quality and transporting it without segregation to the point of placement. Such plants are usually found in the larger localities where a definite permanent investment is warranted. The second method is that of using truck mixers and mixing in transit while en route to the job. A recent estimate indicates that the total production is about equally divided between these two methods.

Manufacturers have provided in such a way for the control of ready-mixed concrete that its quality can be governed with the same assurance as when mixed in the well-known building mixer. Accurate moisture determination in the aggregate at the bins, accurate water-measuring tanks, and batch-meters with locking devices controlling the minimum revolutions of the drum to ensure proper mixing are all available today. Repeated tests and comparisons, made by competent authorities, of concrete produced by the central-plant or truck-mix method have proved that the well-operated commercial plant can produce concrete not only as good as, but better than that which may be expected from the contractor's plant.

TRUCK MIXER DISCHARGING INTO MECHANICAL SPREADER
The Spreading Machine Is Capable of Handling 3 to 4 Cu Yd per Min and of Striking Off for Reinforcing Steel

The truck mixer differs considerably from the conventional building mixer in general design. Its drum is closed while mixing, and the action, instead of a lifting and pouring movement, is a mixing in mass by spirally arranged blades which act as thorough mixing agents with the drum revolving in one direction, and as discharging flights in the reverse direction, without the necessity for tilting the drum. The closed drum further allows for a considerable variation from the approved rating ratio of the standard building mixer, which has been fixed at 3.8 to $4^1/_4$:1 (drum volume in cubic feet to rated capacity), depending on the mixer size. In truck mixers, after careful study, this ratio has been found satisfactory at 2:1 for the $2^1/_2$ yd size and larger, with a slight increase in the two smaller units. When they are used as agitators, their rated capacities are on a ratio of 1.4 to 1.6:1 depending upon the consistency of the concrete to be handled and the carrying capacity of the structural design.

The required mixing time is not given in minutes, but rather in the number of revolutions of the drum, a minimum of 40 to 50 being the recommended practice, based on a speed of from 4 to 16 rpm. The average drum speed is approximately 10 rpm, but irrespective of the speed it has been found that 40 to 50 revolutions will produce a well-mixed concrete. The lower speed is used on long hauls and when used as an agitator.

One of the accompanying photographs shows a 5-cu yd side-discharge truck-mixer discharging concrete into a mechanical spreader. The latter, which is of material advantage in handling the drier consistencies used in highway work when vibrating mechanisms are employed, leaves the concrete ready for the finishing machine to apply the final surface.

Manufacturers have spent thousands of dollars in the study, design, and testing of their equipment to

insure uniformity of mix and to safeguard the mixing operation. Their success is due to this fact, coupled with the realization on the part of the operators that future development is based on careful and honest plant operation. This success is attested by the millions of yards of ready-mixed concrete which have already been delivered and found most satisfactory by engineers.

Truck mixers have also been used very successfully for handling certain types of bituminous mixes utilizing asphaltic emulsions, asphaltic cutbacks, and tars as binder materials, particularly where the grading of the aggregate falls within the limits of $1^1/_2$ to $^1/_4$ in. This new use of truck mixers offers a dual opportunity for use of the initial investment. They can be used not only as stationary plants but as transit mixers for bituminous materials in patch and maintenance work.

New Importance of Welding in Construction

By W. SPRARAGEN

TECHNICAL SECRETARY, AMERICAN WELDING SOCIETY, NEW YORK, N.Y.

DURING the past fifteen years the growth and development of welding has made it one of the greatest tools of modern times. Critics of welding have turned out to be its best friends, for they have forced the welding industry to perfect techniques, materials, apparatus, and procedures. This has resulted in raising the range of tensile strengths of the average welded joint from between 40,000 and 50,000 lb per sq in. to from 65,000 to 75,000 lb per sq in. With special steels and materials, 100,000 lb per sq in. is not impossible. Along with this increase in tensile strength, the ductility of the weld metal has increased from 15 to 20 per cent; the fatigue endurance limit has risen from 10,000 to 28,000 lb per sq in; and impact resistance, as indicated by the Izod test, has jumped from 5 to 50 ft-lb or more. Other physical properties have been correspondingly improved.

The sixty investigations now under way in leading universities, supplemented by several times this number in industrial and governmental laboratories, daily extend the frontiers of welding knowledge and achievements. Our cousins in the leading countries of Europe, in Japan, and in Australia, keep pace and continually challenge any claims of leadership.

DEVELOPING DESIGNS FOR WELDING

The most rapid welding advancement in any specific field of engineering is made by combining the knowledge of the welding engineer with the specialized knowledge of the expert in that field. Welding can never be substituted economically nor at times safely in designs intended primarily for other types of fabrication. To illustrate the necessity of designing for welding—a riveted girder must have angle irons so as to provide a place in which the stress-transmitting rivets may be driven, but if welding is used, the desired end can be accomplished more economically and effectively with flat plates. In castings, certain shapes and sections are used to overcome shrinkage stresses or other difficulties. Certainly these same shapes or sections would not be used if welded rolled-steel parts were substituted.

Each civil engineer can trace in his own field the history and development of certain procedures, designs, or materials. If welding is to be substituted economically and with safety, he must constantly ask himself if it is necessary to do certain things at all, and if so, then whether there is not some better way in which they can be done than by the use of designs developed for riveting. With the help of the welding engineer this attitude will generally lead to designs particularly adapted to welding. Some of the present construction practices represent attempts to overcome difficulties, while others result from peculiar limitations. These same difficulties and limitations may not be effective when a totally different method, such as welding, is used. On the other hand, welding sometimes introduces new difficulties, and new precautions and procedures will be needed to overcome them. In welding, for example, consideration must be given to the matters of residual stresses, stress concentrations, and the desirability of welding downward from above.

These elements are not entirely new to engineers, who have faced similar difficulties in riveting work. No one worries a great deal about the residual stresses in a rolled channel or I-beam, and at times the residual stresses in welding are not important, but at other times it is necessary to take measures to overcome or reduce them. The knowledge that we are obtaining daily in regard to stress concentrations is resulting in remarkable changes in machinery design and fabrication in general, but this is not due primarily to welding. Photoelastic and other types of studies have emphasized the necessity for avoid-

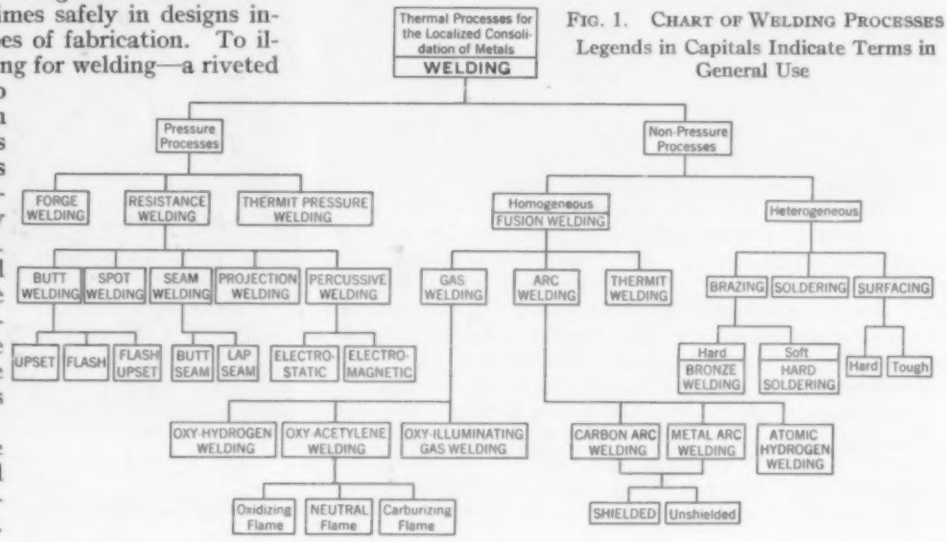


FIG. 1. CHART OF WELDING PROCESSES
Legends in Capitals Indicate Terms in General Use

THE SOUTHERN CALIFORNIA EDISON BUILDING
The Welded Steel Frame of This 13-Story Structure Was Designed to Resist Earthquake Forces

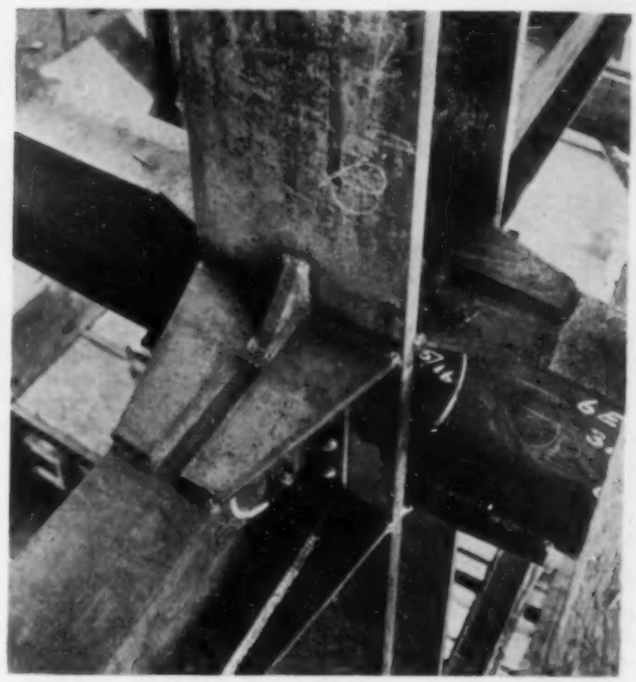
ing stress concentrations and have shown that metal properly used gives not only a more economical product but also a stronger one than a larger amount of metal inadvisedly placed. Some German engineers in a recent paper demonstrated that, by drilling openings at points of stress concentration, they actually strengthened that part for the particular work in hand.

Again it is desirable in welding work to distinguish between dynamic and static stresses. In structures where the principle stresses are static in character, weld metal of low ductility may be adequate, and certain types of joints, such as fillet welds, may be the best. In other cases, the highest quality of weld metal is required, and fillet welds, unless properly made, are not advisable. This is because points of stress concentration result in lower endurance values when subjected to repeated tensile, compression, and impact stresses. The great mass of similar experimental data and service experience which welding engineers have accumulated is now available to the civil engineer.

There is also the economic question. Careful design requires that the amount of welding should be reduced to a minimum. Structural shapes cost a few cents a pound, whereas deposited weld metal may cost a dollar or two per pound. The objective, therefore, should be to use rolled shapes wherever possible, or to combine castings with rolled shapes if the latter will serve the purpose and be more economical. The method of welding is also a matter of economics. As a simple illustration, a $^3/_8$-in. fillet requires approximately one-quarter of the amount of weld metal that a $^3/_4$-in. fillet requires, yet the strength of the smaller cross-section per running inch of weld is more than half as great as that of the larger section.

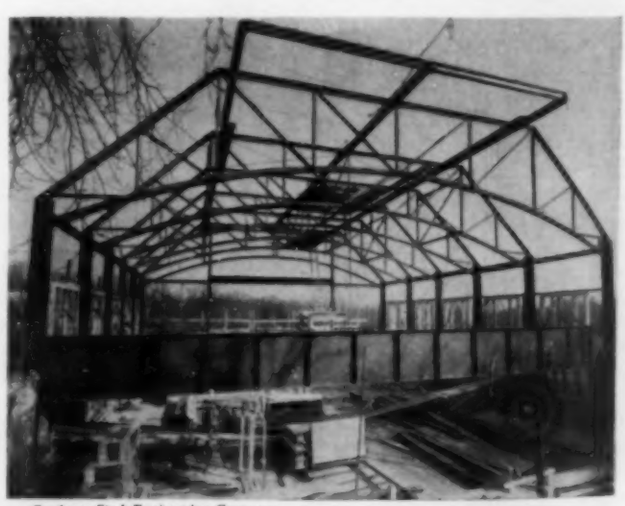
Savings in properly designed welded trusses may run as high as 30 per cent. In a test made to determine the relative merits of riveting and welding, a fabricated riveted girder weighing 798 lb failed under a maximum load of 68,900 lb, while a welded girder weighing 18 per cent less, or 656 lb, failed under a maximum load or 78,000 lb, which is 13 per cent greater.

Ten years ago it would have been fairly simple to indicate in a general way the most suitable steels for welding. The most important requirement would have been that limiting the carbon content to around 0.25 per cent, together with another specifying good clean steel of firebox quality. However, in the last decade the steel industry has produced literally hundreds of new steels,



TYPICAL BEAM-TO-COLUMN WELDED CONNECTION, SOUTHERN CALIFORNIA EDISON BUILDING

with special properties meeting various requirements. Some have high tensile properties or great ductility; others are designed to withstand high or low temperatures, corrosion, impact, fatigue, wear, or combinations of these. These steels may be designated as low or high



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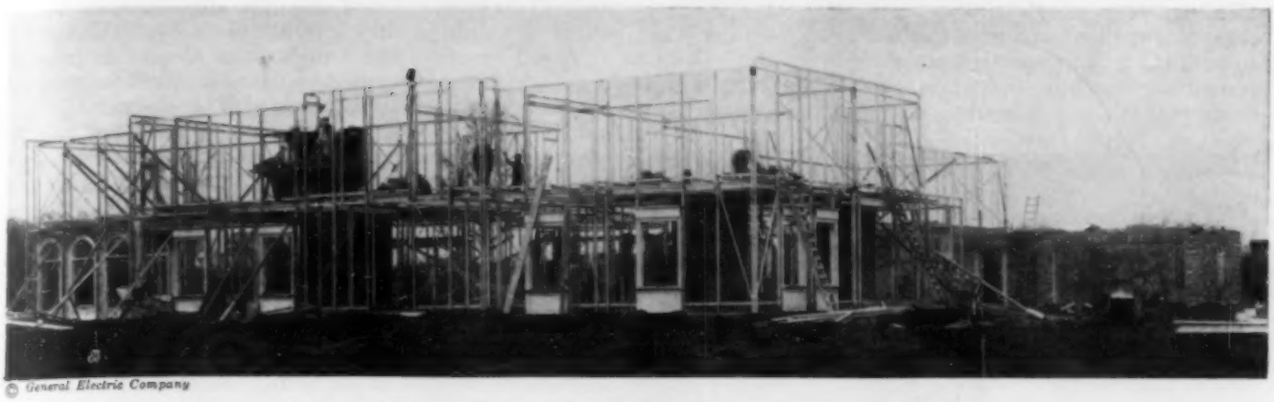
NEW AUDITORIUM FOR SPRING GROVE STATE HOSPITAL, NEAR BALTIMORE
All Steelwork Was Welded; No Bolts or Rivets Were Used



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WELDING USED IN FRAMING LARGE RESIDENCE IN OTTAWA HILLS, OHIO

alloys and may contain varying amounts of manganese, silicon, chromium, nickel, molybdenum, columbium, vanadium, or copper, as well as other elements.

Wide use of welding has led the mills to give careful attention to the welding qualities of the steel, and they have perfected special techniques to give the best results. In using alloy steels, the advice of the manufacturer should always be sought. The greatest precautions are advisable in those cases where heat treatment or heat changes markedly affect the physical properties, although no general rules can be given. Remarkable progress has been made in the development of suitable filler materials and in welding technique. Welds can be obtained with many of these special steels which will approximate the physical properties of the parent metal. The advent of these new steels and the improvement in welding methods are bringing about revolutionary changes in all industries through the use of light-weight high-strength materials.

WELDING OPERATORS AND PROCESSES

In the development of fusion welding, progress has been made only by offering to the user definite assurance of the integrity of the weld. The most positive determination for this is, of course, the non-destructive exploration or test of the welded joint. Where this form of test is not warranted, the plan of qualifying the welding operator by testing welds made by him is regarded as the most effective safeguard for quality of weld.

At one time the quality of welding was regarded as being 90 per cent due to the welding operator. Although it is still of potential importance, most welding engineers will say today that the skill of the operator, on an average, is not more than 10 per cent of the total factor involved and that, for any particular process and type of filler metal, a welding operator will normally do work of a quality as good as his training and ability permit. One of the difficulties most commonly encountered in establishing suitable qualification tests for welding operators is the fact that all such tests are also tests of the welding process. To meet this difficulty, the American Welding Society has under way plans for dividing such qualification tests into two parts, (1) qualification of the welding process and procedure for any group of materials and conditions, and (2) testing of the welding operator to determine his ability to properly apply the qualified process and procedure.

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WELDED CONNECTIONS HOLD AFTER TRUSS IS WRECKED

Twisted Mass of Wreckage Resulting from Explosion and Fire in Lackawanna, N.J.

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WELDED STEEL BRIDGE IN CLEVELAND RESEMBLES CONCRETE

New Highway Bridge Is First All-Welded Structure of Its Kind

The chart reproduced in Fig. 1, prepared by F. T. Llewellyn, M. Am. Soc. C.E., illustrates most of the more important subdivisions of welding. Each of these processes has its own special field of application, although for any specific job there will probably be some overlapping. The selection depends in each case upon local conditions and the nature of the job at hand.

Modern welding apparatus, in keeping pace with the other developments in this field, has steadily grown more

efficient, economical, and dependable. Gas-cutting is regarded, without exception, as the most useful adjunct to welding. Ordinary steels may be cut with an accuracy resembling machine operation, and in fact many machine operations can be reproduced by modifications of

APPLYING A TUNGSTEN CARBIDE HARD FACING MATERIAL TO THE SAW TEETH OF A CAISSON CYLINDER

the gas-cutting principle. Special steels sometimes require individual consideration, but a great mass of data is available and may be obtained for the asking.

WELDING PIPE AT BOULDER DAM

A few recent applications of welding may be of interest. The work on the Boulder Dam project, which includes the fabrication and installation of fusion-welded plate-steel pipes in the hydraulic-power and outlet works tunnels, has required the construction of pipes larger than any heretofore made, the transportation and handling of pipe sections as heavy as many types of standard-gage railroad locomotives, and the exploration of welded seams by the most powerful X-ray equipment available for commercial use. Approximately 45,000 tons of steel plate is being used in fabricating 14,500 ft of pipe of the following sizes:

LENGTH, FT	DIAMETER, FT	PLATE THICKNESS, IN.
4,700	30	$1^{11}/_{16}$ to $2^{3}/_{4}$
1,900	25	$1^{5}/_{8}$ to $2^{9}/_{16}$
5,600	13	$^{5}/_{16}$ to $1^{3}/_{16}$
2,300	$8^{1}/_{2}$	$^{3}/_{8}$ to 1

As most of this piping is too large to permit shipment by railroad, it has been necessary to build a fabricating plant on the rocky slopes above the canyon, about one mile from the site of the dam. The plant equipment includes a plate-bending roll which, for its width, is heavier and more powerful than any made to date; a stress-relieving furnace of sufficient size to accommodate the 30-ft-diameter pipe sections; and a complete laboratory for testing weld specimens.

One piece of 30-ft-diameter pipe approximately 12 ft long is made from three steel plates, each about 32 ft long and 12 ft wide, the largest that can be rolled with existing steel-mill equipment. The thickest plates weigh about 23 tons each, so that only two of these can be shipped in a single car from the steel mill to the fabricating plant. The plates, after being formed, are joined by fusion-welding in accordance with the rules of the American Society of Mechanical Engineers Boiler Construction Code, Unfired Pressure Vessel Section, for Class 1 welding. The fabrication of this pipe involves over 400,000 lin ft of welding. Incidentally, more X-ray film will be required to prove the soundness of the welds than the total which has been used to date for industrial purposes in this country. Two pieces of 30-ft-diameter pipe of maximum thickness, when welded together with a fillet-insert section between them, comprise an erection section which, with support brackets and stiffening rings to hold the pipe in shape, weighs about 170 tons.

NUMEROUS ADVANTAGES OF WELDING IN BUILDING CONSTRUCTION

One feature in the welding of buildings is the elimination of noise. Van Rensselaer P. Saxe, consulting engineer of Baltimore, writes that no noise of riveting hammers disturbed the quiet at the Spring Grove Hospital in Baltimore when a new steel framed building was erected by the use of arc welding. The steel frame of this building weighs 100 tons. Arc welding saved seven tons of steel and reduced the time of erection from weeks to days. Not a bolt or rivet was used either temporarily or permanently in erection. The six trusses were shop-welded in half sections and welded together in the field. The girder was built up of plates joined by welding. Spandrel beams, columns, and roof-frame members are standard I-beams.

Since welding does not enable the designer to materially decrease the amount of steel required in columns, the greatest saving is made from the use of welding in low buildings one or two stories in height and spread over a considerable area. Where tight joints are necessary, welding is of considerable advantage as it is also in many places where corrosion is a serious problem.

Where changes or additions are required to an existing structure, experience has shown that a great saving can be realized by the use of the welding process, whether the original structure was riveted or welded. As it is often difficult to find accurate drawings of such a structure, it has frequently been discovered that when riveted additions were designed and prepared the material would not fit in the field. With welding, steel can be fitted in much the same way as wood. The gas torch is used for cutting to length, and welding may be performed with either the torch or the arc. Moreover, in reconstruction work only a minimum amount of masonry need be removed from the face of a column where additional beams or girders are to be placed.

Mention has been made of the rigidity of welded structures. This is particularly advantageous in designing wind or earthquake bracing for tall buildings, and arc welding is used extensively in strengthening school buildings and other structures in earthquake zones. A total of 29 schools, 18 in the San Francisco Bay region and 11 in Southern California, have been made more resistant to earth tremors by the high tensile strength of shielded arc-weld metal. The high strength of welds made by the shielded arc was shown in the wreckage of the Girls High School, San Francisco. Riveted connections failed to resist the terrific stresses which destroyed this building, but in the entire twisted mass of wreckage not a single welded joint let go.

An oil explosion followed by fire reduced to wreckage an arc-welded steel structure at Lackawanna, N.Y. Here again, examination of the ruins indicated that no welds had given way.

The use of welded steel frames in housing construction offers a most promising field. Undoubtedly the home of tomorrow will be radically different from that of today. Although the changes will not be due primarily to welding, that process will certainly play an important part.

Welded steel frames will probably supplement present types of construction, and it is likely that frameless steel construction will gain popular favor. In this type, semi-finished sections of floors and walls will be built up in the factory and assembled in the field, taking the place of the usual joists, studs, rafters, and sheathing.

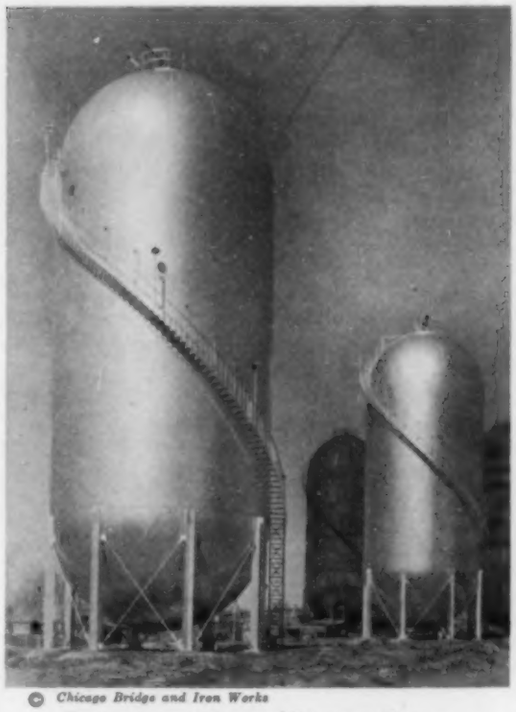
WELDING IN BRIDGE CONSTRUCTION AND REPAIR

The forthcoming bridge specification of the American Welding Society will prescribe unit stresses varying with the range of stresses in a manner similar to those adopted in one or two European countries, but expressed much more simply and in a way capable of easy amendment when American fatigue testing produces more dependable data. The literature will contain complete descriptions of quite a number of all-welded bridges in this country and abroad.

A view of the new $500,000 bridge nearing completion in Cleveland, the first of its type ever constructed, is reproduced in an accompanying photograph. This bridge is of the open-spandrel steel-arch type, 1,260.89 ft long, with a 40-ft roadway flanked on each side by a 5-ft concrete sidewalk. The general appearance suggests concrete, but it is entirely of steel. This effect was achieved by arc-welding all exposed connections. Construction of the 10 towers supporting the bridge was accomplished by butt-welding two 30-ft, 30-ton steel sections for each of the four end towers, and three similar sections for each of the six intermediate towers. Each butt weld contained 34 ft of welding. The floor beams were also tied together by boss plates attached by welding.

An all-welded steel-truss highway bridge was recently completed at Riverside, N.J. This bridge, which is 397 ft long with a 36-ft roadway and a 5-ft sidewalk, involved about 24,000 lin ft of welding and cost slightly more than $250,000.

Ten thousand dollars was saved recently by the City of Cleveland when the badly corroded eye-bars forming the lower chord of a 50-year-old bridge were strengthened by arc welding. This bridge, which spans railroad tracks, had been damaged by heat and corrosive elements discharged from locomotive smokestacks. Badly corroded parts of the eye-bars were chipped away to expose sound metal. Steel plates were then inserted between them, welded in place, and the openings filled with weld metal. After welding, smoke plates were welded to the top and bottom to protect the eye-bars from further corrosion. A total of 500 ft of welding was required.



© *Chicago Bridge and Iron Works*

BLIMP-SHAPED BUTANE STORAGE TANKS

These 34 by 86-ft Tanks Are Good Examples of All-Welded Construction, Although Many Prefer the Spherical Shape from a Structural Viewpoint

WELDING ENTERS A NEW ERA

In 1922 the Australians led the world in the design of large-capacity gas holders, the first being of 3,000,000-cu ft capacity. During recent years this country has followed suit in the construction of all-welded tanks for various purposes.

In pipe-line construction, welding is now the accepted method. A saving of 30 per cent and more in the original cost of water, oil, and gas lines is no longer a rarity, and in addition, welded steel pipe insures greater strength, longer life, and greatly reduced maintenance.

Almost all of the newer equipment used by the civil engineer in construction work is welded at least in part. Welding gives the necessary strength for the severe punishment received by such equipment. The oxy-acetylene cutting torch and the various welding methods have proved indispensable in providing stronger, lighter, and more economical parts. The life of wearing parts has been increased in some cases from ten to twenty times by the application of hard facing or surfacing.

A new era is now well under way in the steel and metal industries, due primarily to the development of high-strength material which results in lighter-weight construction, improved quality, and economies in cost. Welding and cutting have proved important tools in obtaining maximum advantage from this light-weight construction. The first applications will of necessity be in places where savings will result, but gradually the use of these superior materials will creep into every form of construction. Engineers must of necessity keep abreast of the latest developments, and as the reliability of these products are demonstrated, their use will increase.

Advances in Structural Erection Practice

By DAVID S. FINE

ASSISTANT ENGINEER, ERECTING DEPARTMENT, AMERICAN BRIDGE COMPANY, NEW YORK, N.Y.

ADVANCES made in recent years in the methods and equipment used in the erection of steel structures represent the improvement of existing methods and equipment rather than the development of new ones. Owing to increased highway construction, these improvements have occurred largely in connection with the erection of highway rather than railroad structures, although there are examples in both fields.

The introduction of the railroad erecting crane about twenty-five years ago revolutionized the erection of railroad bridges and other structures where the crane could be delivered to and operated at the site. In the same way, though it must be said to a lesser extent, the improvement of the tractor or crawler crane has greatly influenced the method of erecting highway bridges, viaducts, tier and mill buildings, and various other structures. These

cranes, developed originally from the excavating shovel, are manufactured today especially for the hoisting and setting of structural steel. The modern tractor crane, equipped with control devices, embodies many improvements, and has in many cases proved itself more economical and flexible than a derrick or traveler. These cranes are manufactured with capacities up to 40 tons and boom lengths up to 125 ft. Through the use of boom extension or gooseneck-type jibs, they can set pieces in out-of-the-way positions. For hoisting heavy pieces two or more cranes are used. Cranes are delivered on low trailers to the site, where they can be made ready for operation in a short time. The ability of such cranes to pick up the load and travel with it has made them very useful for sorting and yarding steel.

The truck crane has been introduced for handling pieces of 6 tons or less in weight and has proved useful in erecting light work such as tanks, garages, and towers. This crane consists of a hoisting unit mounted on an auto truck, equipped with a boom up to 50 ft in length.

TRACTOR CRANE EQUIPPED WITH 70-FT BOOM AND 20-FT GOOSE-NECK JIB ERECTING STEEL FOR SCHOOL BUILDING

A necessary accompaniment to the development of the tractor crane has been the improvement in trucking equipment. In the erection of most highway structures, the steel must be trucked to the site. Following the design of the gooseneck trailer used for hauling tractor cranes, other types of low, flat trailers were developed. These made possible the trucking of long and heavy pieces from the railroad unloading yard to a location at the site, within reach of the derricks or tractor cranes. By means of adjustable racks fastened to the body of the trailers, girders up to 13 ft in depth can be hauled in an upright position, thus eliminating the necessity for unloading and setting them upright before they are hoisted into place. In one case a girder 125 ft in length and weighing 135 tons, was hauled upright over the streets of New York City. These trailers have heavy solid-tired wheels carried on rocking axles, which permit the wheels to adjust themselves to irregularities in the road. Trailers of a similar design but of lighter capacity are used for hauling over soft surfaces. This latter form of tractor, which has a capacity up to 50 tons, is provided with large pneumatic balloon tires instead of solid ones.

Since it is so rarely necessary to maintain traffic during the erection of a highway bridge, as is the case with most railroad bridges, a distinct trend is evident toward the use of the cantilever method of erection and a minimum number of falsework supports. As these bents carry heavy concentrated loads, they are usually made of steel and are in some cases adjustable. In the adjustable type, columns, struts, and diagonals are telescopic, so that they can be erected as bents of various heights and widths and thus used for many structures. These bents are equipped with hydraulic jacks for raising and lowering the load, and are supported on temporary foundations such as spread footings or piles. Where conditions make it desirable to use steel bearing piles for this purpose, the piles are driven through and connected to a heavily braced steel cage, which serves not only to hold the piles in their proper position but also to provide lateral stability for the pile foundation.

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HAULING 65-TON GIRDER UPRIGHT ON PNEUMATIC-TIRED TRUCK AND TRAILER

This Type of Transportation Is Being Increasingly Used

ERECTING 60-TON GIRDER WITH TWO TRACTOR CRANES CARRYING 80-FT BOOMS

Where a bridge is under construction in a location such that the steel can be shipped in barges directly from the fabricating plant to the site, it may be desirable to start erection directly from a river pier. In several

such cases an ingenious use of the guy derrick has been made. It is erected at the foot of the pier, raised to the top, and there converted into a simple light traveler for cantilever erection.

TWO-STAGE AIR COMPRESSORS AND BOLT-TIGHTENING MACHINES

With the increasing use of rivets up to $1^1/_4$ in. in diameter, made in some cases of manganese steel, thought has been given to the development of equipment capable of facilitating rivet driving and reducing its cost. Until recently, the standard air compressor was designed to deliver air at a pressure of only 100 lb. This pressure was hardly sufficient to drive large-sized rivets, particularly those with a long grip and those made of alloy steel. It is not surprising that the compressors were thus often operated at a greater pressure than that for which they were designed, with a resulting increase in cost of maintenance and repairs. Later a second compressor or booster was connected to the first, raising the pressure to 150 lb. The need of air pressure delivered at 145 to 150 lb became increasingly apparent, and within the past year the two-stage compressor, designed for a pressure of 150 lb, has appeared on the market. No doubt this machine will eventually become the standard unit and lead to a more general use of high-pressure air for riveting.

GUY DERRICK TRAVELERS ERECTING TRUSS SPAN AT RIVER PIER, NEW ORLEANS BRIDGE
In the Foreground Is an Adjustable Steel Falsework Bent Resting on Steel Bearing-Pile Foundations

Another aid to riveting supplies mechanical means for tightening the fitting-up bolts used for holding steel members in place preparatory to riveting. The earlier type of machine functioned on the principle of a pneumatic rotary motor. It was provided with a long handle for application to the nut of the bolt, and it required two men for operation. The later type of machine, introduced recently, operates on the impact principle, striking blows with a rotary motion. It can be operated by one man only. Both types of machine, by rapidly screwing up the nuts and drawing the various thicknesses of metal tightly together, have proved to be great aids in reducing the cost of riveting. They constitute one of the very few new pieces of equipment introduced in structural steel erection in recent years.

The use of welding, both in erecting new structures and in reinforcing existing ones, has increased a great deal in recent years. This subject is very thoroughly discussed in another paper in this symposium.

SOME OTHER RECENT TRENDS

More attention is being paid to weight in the design of traveler derricks, and their members are being made of silicon steel. In many places pins and other forgings are made of heat-treated alloy steel. Attention has been given to the problem of reducing friction in rotating parts by the use of ball or roller bearings in the sheaves of blocks, in the derricks, and in the drums of hoisting engines. The use of anti-friction bearings has resulted in a saving in power and a decrease in the maintenance costs of the rotating parts.

Extensive changes have taken place in the type of motive power used for operating erection equipment. Steam, a flexible source of power but one that embodies many undesirable operating features, has largely given way to electricity. Electricity, in turn, has been replaced by gasoline to some extent. This is largely because of the high cost of electrical installations, and variation in the characteristics of the current available in different places. Within recent years, low-compression oil engines and Diesel engines have been introduced for operating air compressors, hoisting engines, and tractor cranes. Economy of operation and flexibility in delivering power points toward their universal adoption in the future.

Advances have been made in the reduction of accidents incident to steel erection. Accident prevention and safety have become important elements on every job. The use of hats made of hard-pressed material to protect the heads of the men, special shoes with soles tough enough to resist the entrance of nails and at the same time flexible enough to grip the steel, safety belts by means of which the men can tie themselves to the structures, and special scaffolding, all combined with constant vigilance in the inspection of equipment, have played a large part in reducing accidents.

IMPACT-TYPE BOLT-TIGHTENING MACHINE
This Machine, Operated by One Man, Will Rapidly Screw Up the Nuts on Fitting-Up Bolts. The Earlier Form Was Provided with a Long Handle and Required Two Men for Operation

City and County Planning Problems

Indifference of Officials and Public to Future Needs Hampers Progress of Civic Betterments

DURING periods of economic stress, thoughtful persons make such plans as seem to promise future avoidance of present difficulties. Others apparently take no heed, but at the first opportunity hasten to repeat the speculative practices which have over-developed the suburbs of our cities and lowered established values in the central areas. As a means for correction, Mr. Bartholomew proposes that each city adopt a suitable constructive land policy looking toward rehabilitation of blighted areas while encouraging the citizens in each neighborhood to maintain existing building and zoning restrictions. Mr. Lewis's article, on the other hand, deals with regional and county, rather than municipal, planning, and concerns itself with the obstacles encountered by planning projects conducted under work relief. The planning consultant must persuade local planning boards to sponsor projects and must follow them through the rather complicated channels necessary for WPA approval, with attendant difficulties. It is then discouraging to discover, as he often does, too few persons on the local relief rolls qualified to supervise, or in some cases even to man the work adequately. More active interest in planning on the part of federal and local officials and the public is highly desirable. These articles are abstracted from papers presented on January 16, 1936, before the City Planning Division at the Annual Meeting of the Society.

The Future of Land Subdivision

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FOR more than half a century the cities of the United States have experienced an unprecedented growth. In 1870 the total population of the United States was 88.4 per cent rural and 11.6 per cent urban, while in 1930 it was 43.8 per cent rural and 56.2 per cent urban. The total urban population was 10,095,000 in 1870 and 68,955,000 in 1930.

This remarkable increase in total urban population has produced many new cities and has expanded most of the existing ones. The subdivision of land for residential use has become a familiar community activity. Civil engineers have found much employment in land subdivision work by surveying land and by the design and construction of water supply, sewers, pavement, and other utilities. What problems confront the engineer engaged in this type of work? If the engineer is to continue to render a useful service to society in this field he must acquaint himself with the broad social and economic trends which underlie the growth of cities and the conditions of life in urban communities. The discussion which follows is merely an attempt to indicate the more significant problems and their implications. It will be the object of the Committee on Land Subdivision of the City Planning Division to treat these problems more in detail and to suggest improvement in present practices. A set of conditions more challenging to the traditional resourcefulness of the engineer has never before been offered.

The actual process of subdividing land into lots for building purposes, that is, the preparation of subdivision plats, has been performed in the past both by engineers and by landscape architects. In recent years, moreover, studies of low-cost housing involving resubdivision of land in slum districts and the preparation of community planning schemes on vacant land have been undertaken by architects. The work in fact involves an integration of the best talent of all three professions. Land subdivision should take into account all the physical, social, and economic questions involved in each particular instance.

What is the field of the engineer, the architect, and the landscape architect in the process of land subdivision? Frequently the engineer has been employed initially to determine the nature of the subdivision, to make the general design plan, and to design and supervise construction of improvements, with the architect and landscape architect employed separately by each lot owner. In recent years many large subdivisions have been designed and built by landscape architects, who employ engineers for design and construction of utility services. This practice has developed because of too many stereotyped plans laid out by unimaginative engineers who lacked a thorough understanding of what people want in home neighborhoods. Of course, much bad design can be attributed to landowners who employed no professional services at all.

THE TOWERS APARTMENTS, JACKSON HEIGHTS, N.Y.
Illustrating Attractive Treatment of Limited Rear Garden Space

It must be admitted, however, that landscape architects have taken over an appreciable part of land subdivision work because of their more attractive designs and possibly also because of some saving effected in grading and utility costs. But

in this there have been errors too.

There is room for endless discussion of the extent to which members of each of the three professions should be responsible for land subsidivision. No one of the three should have an exclusive monopoly, and none has yet demonstrated an exclusive talent for determining character and general design. There is room for much improvement in this field.

While the subdivision of land into building lots is a determining factor in the form of cities, until recent years there has been no public control of its character, location, and extent. An over-supply of vacant lots, many poorly designed subdivisions, and instability of growth are the results.

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LITTLE NECK, N.Y.; COMPARE CLOSE SPACING OF HOUSES IN LEFT BACKGROUND WITH LARGER LOTS IN FOREGROUND

HOW MUCH NEW LAND SUBDIVISION IS NEEDED?

It has been predicted that the total population of the United States will become stabilized between 140,000,000 and 145,000,000 within the next 20 to 25 years. It has also been suggested that decentralization of industry will take place. A recent study of industrial decentralization (*Is Industry Decentralizing?* by Daniel B. Creamer, Wharton School, University of Pennsylvania, Study of Population Redistribution, Bulletin No. 3) discloses that 75 per cent of the wage jobs in industry in the United States are concentrated in 200 counties. Locational trends indicate, however, that while industry may decentralize within the limits of a metropolitan community it will not be dispersed into wide rural areas or small cities and towns.

If we assume a national population of 145,000,000 in 1960, this will represent an increase of only slightly over 18 per cent of the total population, according to the U. S. Census of 1930. It is generally believed that the percentage of increase in urban population will exceed the average total increase, and that the major part of urban population increase will occur in the metropolitan regions of large cities. And so it may be that we should anticipate an increase of about 25 per cent in the latter. But the present supply of vacant lots in large cities represents from 30 to 50 per cent of all the lots now used for buildings. It would seem, therefore, that we need comparatively little new land subdivision. However, since our cities are not satisfactory in character, we are still confronted with the problem of how and where new population in each city can be provided for to best advantage.

WHERE SHOULD LAND SUBDIVISION TAKE PLACE?

Approximately 50 per cent of the total urban population is found in cities of less than 100,000 population. The problems of land subdivision in cities of less than 100,000 population are quite different from those in the large metropolitan city. In smaller cities new population is usually provided for in new houses in the outskirts, whereas in metropolitan cities new population frequently finds accommodation in old houses, while new subdivisions in the outskirts are designed for families of large income who move out from older districts. There is also considerable shifting of population within the metropolitan cities, whereas the population in smaller cities is relatively stable. There has been less land speculation and less premature subdivision of land into building lots in the smaller cities. Single-family houses on large lots have been the predominant form of residential development in the smaller communities, which accordingly have had comparatively few land-subdivision and housing problems.

The present general type of land subdivision practice in smaller cities is not undesirable and will probably continue. However, better adjustment of streets to topographical conditions and less rectangular street patterns would be advantageous. Modern land-subdivision control regulations should be adopted in all cities, particularly where suburban growth is expected. It is the object of a special com-

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THE AREAS CONTAINING SHADE TREES DIFFERENTIATE FOREST HILLS GARDENS FROM THE OTHER PARTS OF FOREST HILLS, N.Y.

mittee recently appointed by the City Planning Division of the Society to prepare and publish a manual of modern land subdivision practice.

Generally speaking, a city of less than 100,000 population is not so large but that the majority of its population can be housed in single-family dwellings of low population density without having abnormally long distances to travel to places of employment. A city of 100,000 population housed in dwellings at the rate of four to the acre would occupy on the average 21.7 sq miles, of which the residential area would constitute only 40 per cent. Assuming that it is developed as a centralized city, a maximum traveling distance of less than three miles would be involved between home and business. Unquestionably the desirable standards of housing now found in most of our smaller cities can be maintained by continuing to build single-family houses on large lots.

A CUL-DE-SAC STREET IN FOREST HILLS, N.Y.
Trees and Shrubs in Center Islands Improve the Appearance of Thickly Settled Residential Areas

A VIEW IN KOHLER, WIS.
Land Subdivisions in the Smaller Communities Are Characterized by Larger Lots

When we come to consider the larger metropolitan cities, however, the situation is different. Smaller lots and higher population densities prevail, and yet the city is widely spread, necessitating long distances to travel. More intensive housing is found, such as flats, boarding houses, multiple dwellings, and hotels. Speculative practices have produced a chaotic mixing of building types. The older, centrally located residential areas are steadily losing population. Suburban districts are growing in population, but too often the mistakes of overcrowding the land and poor building construction are being repeated. The important question is then whether to provide new land subdivision and buildings on the outskirts for the new population or whether to resubdivide the land and build new structures in the older, centrally located areas.

It has been suggested that the metropolitan cities should be broken up into a series of small self-contained communities separated by belts of open space. The Resettlement Administration proposes to build four such communities of from 1,000- to 1,500-family living units each. This is a worthy ideal but impossible of attainment for a whole city or any large part of it because of the enormous cost involved, the dislocations that would be necessary, and the insurmountable political complications. There would very likely be as many inconveniences and complications in such a community design as exist in the present city. Our present cities are unsatisfactory because of inadequate control of the use of land, but they are not impractical in form, and it is therefore more logical to plan for a gradual rebuilding of their present structures.

WHAT SHOULD BE THE FORM OF SUBDIVISION IN CITIES?

Lack of coordination between the developer, the builder, and the financier has been the gravest error in past methods of subdivision and use of land in cities. In smaller cities the complete separation of developer, builder, and financier is not necessarily impractical, but this is an impractical ideal in a large city. In the Borough of Manhattan, New York City, less than 1 per cent of the people own the homes they live in. The trend is the same in the older areas of all large cities. The greatest opportunity for individual enjoyment in a large city comes from certain forms of community action. This is particularly true in the matter of property development. The individual is powerless to control his environment in a large city, but individual satisfaction is not promoted by overcrowding of land, instability of values, or wholesale shifting of population.

Land subdivision in large cities should take place only after a broad pattern of community development and of population distribution has been determined. To build up suburban areas by the depopulation of older, centrally located areas is wholly impractical. Eventually someone must pay the bill. This practice will stop when all its costs are known. Land subdivision in large cities should consist largely of the resubdivision of land and the demolition of buildings in the older areas, where often the buildings are obsolete, city services cost two to five times the taxes levied, and social conditions are a menace.

NEED FOR DEFINITE URBAN LAND PROGRAM

The large American city is economically unsound because of inadequate planning, and there is need for a new approach to the whole problem of residential development. Since it is impractical to completely rebuild our large cities, reorganization and reconstruction should be based on a constructive urban land policy embracing the following points:

1. Limitation of the areas of growth in accord with actual need through control of all land subdivision.
2. A high standard of building-code regulations for all building development within all parts of a community, including its suburbs.
3. A revision of zoning regulations in scale with known laws of supply and demand for each different class of property use.

4. Rigid enforcement of sanitary laws and fire laws to insure cleanliness in all classes of residential property.
5. Removal of all obsolete structures.
6. Repair and renovation of buildings that are unsafe or unfit for human occupancy.
7. Reorganization of tax methods based upon actual use and earning power (and with some check upon harmful speculative practices).
8. Comprehensive long-time housing program.
9. Organization of all residential areas into a comprehensive pattern of neighborhood units.

Footways Provide Free Access for Pedestrians and Children

Short Dead-End Streets Provide Vehicular Access to Houses

TYPICAL VIEWS IN RADBURN, WELL-PLANNED NEW JERSEY MUNICIPALITY

European cities have long enforced urban land policies of this nature. American cities cannot longer afford to tolerate urban land policies based upon uncontrolled or inadequately controlled speculative forms of growth.

Unfortunately space does not permit discussion of the several elements that have been outlined. However, the neighborhood unit has such a direct bearing upon the subject of land subdivision that a brief comment follows.

THE IMPORTANCE OF THE NEIGHBORHOOD UNIT

The predominant need in the rehabilitation and reconstruction of the American city is a good environment. Securing a good environment within cities involves consideration of a new unit of land—a minimum area of approximately one-half square mile, although it is difficult to fix an arbitrary specification. Future land subdivision in the large American city should be based upon the development of such large neighborhood units, forming part of a general community design.

Nearly all residential areas have attempted to protect their environments through deed restrictions at times of initial development. Unfortunately most such areas were too small in size for complete protection of environment, so that when deed restrictions expired it was impossible to secure unanimous approval for renewal. If the community is to protect and preserve its residential areas it must aid its citizens to organize their residential areas into neighborhood units. In suburban areas this will involve forming an organization of home owners for the maintenance of existing restrictions. In blighted districts it will involve rezoning, elimination of nonconforming uses, and reestablishment of protective restrictions. In slum areas it can be achieved only by large-scale reconstruction.

Legislation is needed to permit the organization of the residential areas of a city into neighborhood units for purposes of protection and improvement of environmental conditions. Desirable neighborhoods in a city cannot be achieved by limiting individual action; there must be some new form of constructive action by majority groups. It is difficult to predict what form of law will meet with the approval of the courts, but certainly there is no longer any doubt as to its desirability.

In St. Louis it is estimated that approximately 40 of the 62 sq miles of city area will be devoted permanently to residential and supplementary uses. This area has been divided tentatively into 82 neighborhood unit areas in which it is hoped to arouse the interest of citizens in their common problems. Much of this area is now blighted. Its future is not bright unless there is (1) a well-enforced constructive urban land policy, and (2) some form of local organization in each neighborhood to see that desirable objectives are attained.

The American city has been built upon the basis of the individual lot, regardless of its size or its suitability and regardless of the net result of a multitude of unrelated lot subdivision patterns. In recent years American cities have spent hundreds of millions of dollars attempting to correct the evils of such methods—but without any attempt to change the methods themselves. Cannot we in America devise new forms of land subdivision which will provide better dwelling arrangements and better cities?

A REALISTIC APPROACH TO PROBLEMS OF LAND SUBDIVISION AND HOUSING

A genuinely realistic approach to the problem of land subdivision and housing in any city would involve the following steps:

1. Determination of probable ultimate population.
2. Determination of number of families in each income group.
3. Estimate of number of families that could be accommodated in detached single-family dwellings on individual lots.
4. Estimate of number of families that could be housed to best advantage in group housing or by some form of community planning.
5. Determination of most desirable pattern of population distribution.
6. Determination of the extent to which present housing facilities are logical and satisfactory.
7. Estimate of amount of land subdivision needed for new single-family dwellings.
8. Estimate of amount of land subdivision or resubdivision needed for group housing.
9. Preparation of a long-time land subdivision and housing program, with estimates of annual volume of construction needed.

10. Creation of a local planning and housing authority to make the foregoing determinations and to aid in the preparation of detailed standards and designs for individual projects.

In a metropolitan community such as New York, Philadelphia, or St. Louis, where the area of urbanization overlaps state boundary lines, a separate planning and housing authority would be necessary in each state.

Our cities are badly planned because the whole process of land subdivision and dwelling construction lacks direction and has never been related to the public need. On the contrary it has been motivated by a speculative market less concerned with desirable standards than with profitable returns. There will be just as much return for private enterprise in a properly adjusted program of land subdivision and housing as in present hit-or-miss methods, and there should be far more stability for the building industry.

Practical problems to be dealt with in each city or region according to local conditions are population density, pattern of neighborhood unit areas, street arrangement, block sizes, lot sizes, open-space areas (parks, playgrounds, and institutional areas), amount of local commercial area, and standards of community planning.

Population density requires far more study than has yet been devoted to it. In many small cities it is now regulated quite satisfactorily through zoning ordinances. Most cities, however, either have permitted unlimited population density throughout much of their area or have adopted standards that are wholly unreasonable. This matter is essential and must precede the establishment of land subdivision and community planning regulations.

The standard of eight houses to the acre now being used in England is a reasonable, even a generous standard for the majority of American cities. In general, our cities have less density than this in outlying areas but more in central areas. Each city should plan in accordance with existing and probable future conditions, but the abnormal densities that prevail in certain speculative practices should not be permitted. Even the Public Works Administration's Housing Division has fallen into the error of fixing too high a population density in its projects because of presumed economy. High land values do not constitute any excuse for overcrowding the land, which merely creates new problems in the attempt to evade existing ones. Land values, assessments, and the location of different types of dwelling construction must be adjusted to secure a balanced arrangement.

At four houses to the acre, a city of 100,000 population can be accommodated within an area of less than three miles radius. At eight houses to the acre a city of 500,000 population can be accommodated within an area of less than 7.5 miles radius. These figures, which are based upon assumptions of 4.5 persons per house, no large unoccupied areas, and 40 per cent net area of land used for residential purposes, demonstrate that there is no need for tall tenements or small houses on small lots. Most of the population can be accommodated in small cities in detached single-family dwellings on lots of 50 by 125 ft or the equivalent, and in larger cities, in detached single-family dwellings on lots of 50 by 100 ft or the equivalent. Where population is provided for in flats or tenements, the population density rarely need exceed double these densities, that is, 72 persons per acre net or 54 persons per acre gross. More land area for flats and tenements would be desirable for the occupants, for the owners, and for the city.

Careful planning of subdivisions will reduce the area normally given to streets, save costs of maintenance, and produce more livable conditions, as was demonstrated by Russell V. Black, M. Am. Soc. C.E., in a special study published in the report of the New Jersey State Planning Board.

While the use of the individual lot is desirable for detached single-family dwellings, its desirability for more intensive forms of dwellings is questionable. The studies of Henry Wright have demonstrated the superior advantages of community planning in the field of low-cost housing. It is difficult to suggest any standards of development in this field other than the necessity for keeping population density within reasonable limits. The success of community planning schemes is dependent upon careful design, adequate open spaces, and prevention of speculative abuses, and its advantages need not be confined to low-cost housing projects. Our cities can be recreated by cooperative neighborhood action and the introduction of new types of community facilities and improvements, and it is even conceivable that numerous economies can be thus achieved.

Planning Programs Limited Under Work Relief

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IN so far as it relates to county and municipal planning projects being carried out by the Works Progress Administration, this is very largely a story of what might have been. On the other hand, state planning with work relief forces has been effectively established throughout the country with the aid of the National Resources Board and its successor, the National Resources Committee.

On the first of November 1935, the outlook for any additional planning under work relief looked rather hopeless. Available funds were rapidly being allocated to other types of projects, and planning projects continued to be shuffled back and forth between state and federal agencies without making any substantial progress. Then a life-line was thrown out to state planning in the form of a nation-wide project, sponsored jointly by the National Resources Committee and WPA, to provide nucleus staffs for state planning boards.

December 1, 1935, was the latest date originally set for approval of new projects, but about that time the tide began to turn for county and municipal planning projects. It developed that such projects could still be submitted and for the first time Washington relief officials evidenced active interest in having projects of this character set up to provide work for technical and clerical relief cases.

TYPES OF PLANNING AND THEIR PROGRESS UNDER FEDERAL WORK RELIEF FUNDS

A complete list of the various types of planning that are being promoted with the aid of federal funds follows:

1. National planning, as represented by the work of the National Resources Committee and the previous National Planning Board.
2. Regional interstate planning, as represented by the Pacific Northwest Regional Planning Commission and the New England Regional Planning Commission.
3. State planning, as carried on by planning boards in 46 states.
4. Metropolitan regional planning as carried on by the National Capital Park and Planning Commission and in a few of the other metropolitan areas.
5. County planning.
6. Municipal planning.

Steady progress has been made in state planning. At the close of CWA there were 37 boards functioning; in December 1935 there were 46; and it is safe to predict that these will all continue under the nation-wide WPA project.

Unfortunately complete data for a nation-wide analysis of county and municipal planning are missing. Neither the National Resources Committee nor WPA could supply complete figures at the close of 1935 on either the cost or the number of such projects.

The Regional Plan Association has, however, compiled figures for New York and its environs, where about 12,000,000 of the country's population is concentrated. The region covers all or parts of 17 counties outside of New York City, which itself contains five counties. Fig. 1 shows the location and relative activity of this metropolitan area under the two earlier forms of work relief administration.

FIG. 1. NEW YORK CITY AND ENVIRONS

Showing Progress in County Planning with Work Relief Forces Under the Civil Works Administration and the Temporary Emergency Relief Administration, as of August 1935

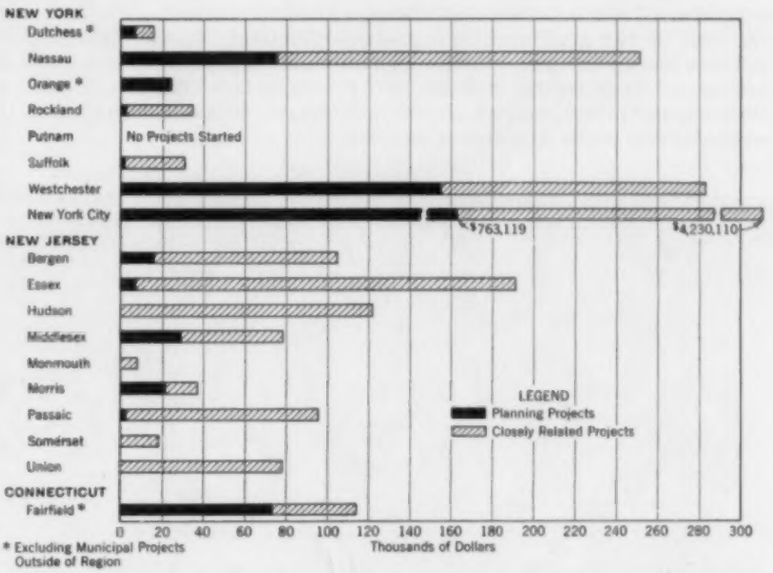

FIG. 2. FUNDS EXPENDED ON WORK RELIEF PLANNING AND ALLIED PROJECTS In New York City and Environs as of January 31, 1935

Up to January 1, 1935, New York City and 13 of the suburban counties had completed planning studies by state, county, or municipal agencies involving CWA and TERA (Temporary Emergency Relief Administration) appropriations of about $1,174,000. In the other four counties no planning projects had been set up. In the region as a whole additional projects, not strictly planning but related thereto, involved an expenditure of about $4,553,000. These expenditures are graphically illustrated in Fig. 2.

Considering county planning alone in the 17 suburban counties, the following figures show the trends under the various relief agencies:

Under CWA, 7 counties had county-wide planning projects.

Under TERA, 7 counties had county-wide planning projects, including 5 of the above and 2 new counties.

Under WPA, only 2 counties had projects in operation by January 16, 1936, but projects in 2 additional counties had been approved by the Federal Coordinating Committee. The status of these projects is shown in Table I.

New York City carried out a number of planning studies under CWA. Under TERA a city-wide study was set up under the Mayor's Committee on City Planning (Fig. 3), and this has been continued under WPA with an allotment of $700,000.

DIFFICULTIES IN SECURING ADEQUATE PERSONNEL

Under CWA, where need of a job was the only qualification required, it was possible to secure high-grade professional and technical services, and it was generally possible to select suitable supervision. Under the work divisions of the various state emergency relief boards and their successor, WPA, only those eligible for home relief have been available as workers. A very limited percentage of supervisors has been obtainable from the relief rolls, but in many cases it has been impossible to get a sufficient number of such men assigned.

This situation, of course, has varied widely in different parts of the country. In the metropolitan areas it has often been possible to obtain architects, engineers, and landscape architects who, through their special training, have been able to make real contributions to planning

projects. After a nucleus of such men has been formed, the rest of the staff can be organized effectively from persons having clerical, statistical, and stenographic experience. Economists, writers, artists, social workers, realtors, and other groups have also made important contributions on staffs of planning projects.

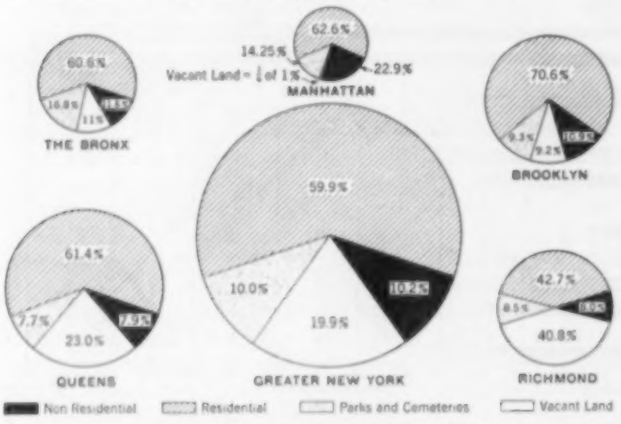

FIG. 3. HOW NEW YORK CITY USES ITS LAND

Predominant Usage by Blocks as Determined by the Mayor's Committee on City Planning from Information Collected by the 1934 Real Property Inventory

In the smaller cities the problem has been more difficult. While it may have been possible to gather a fairly satisfactory working staff, the provision of adequate supervision has been difficult. Regular technical employees of municipal departments have had to be depended upon, and it has been exceptional to find anyone with a real conception of how to go about the job.

In the rural areas it has been very difficult indeed to find either a working staff or supervision to justify setting up a project. The few professional and technical men in such communities seem to have been able to keep off the relief rolls, and in several cases projects that were successfully operated under the CWA have had to be abandoned at its close.

WIDE VARIETY OF SUBJECTS FOR PLANNING PROJECTS

There has been considerable confusion as to what constitutes a desirable planning project, particularly in state and county planning, which are relatively new. The newer types of planning have spread out to cover a wide range of subjects, including engineering, architecture, economics, social problems, finance, administration, taxation, and others. It seems likely that from this list there will emerge a more restricted group of subjects on which state and county planning should concentrate. Two contributions toward the definition of state and county planning should be mentioned—the conference called by the American Society of Planning Officials at Cleveland in December 1935 to discuss state planning and its application, and the bulletin published in October 1935, by the Regional Plan Association,[a] New York, N.Y., on "Objectives and Procedure for County Planning Programs."

The metropolitan types of regional and municipal planning have dealt primarily with problems of transportation, land uses, zoning, subdivision, and recreation.

All the various types of planning embrace the following stages:

1. Gathering facts bearing upon the physical development of the area.
2. Subjecting these facts to careful scrutiny and analysis.
3. Drawing up constructive suggestions in the form of a comprehensive plan.
4. Keeping this plan before the officials and citizens making important decisions affecting the community's growth.

A work relief organization under present-day conditions cannot be expected to advance beyond the second of these four stages, that is, the gathering and analysis of facts. However, this type of work is essential, particularly in a community where official planning is new and the groundwork is still to be laid. Where official planning boards are well established, are provided with budgeted funds, and have either a full-time staff or the services of a consultant, more can be done. In such cases the work may include drawing up at least parts of a comprehensive plan, but even so it is necessary to lean upon the permanent staff and consultant for most of the constructive planning. In a smaller community a single man as resident planner or secretary of a planning board can make great progress with the aid of a few men assigned from the work relief rolls.

OBSTACLES TO APPROVAL OF WORK RELIEF PROJECTS

The fundamental obstacle in getting planning projects approved by the various work relief administrations has been the fact that no recognition was given to them as such in the procedures prepared by the federal officials. This matter was discussed by the City Planning Division meeting in January 1935, and its executive committee was authorized to call it to the attention of the officials

TABLE I. PROGRESS CHART OF COUNTY PLANNING PROJECTS IN NEW YORK CITY AND ENVIRONS UNDER THE WORKS PROGRESS ADMINISTRATION, AS OF JANUARY 16, 1936

COUNTY	E R A Planning Project	* R.P.A. Sample W P A Project	Submitted by Sponsor	Approved by: District Office	Approved by: State Office	Funds Allocated	Office Established	Staff Assigned	Work Started	Notes
N. J.										
Bergen	■		■	■	■	■	■			
Essex		■	■	■	■					
Hudson		■								
Middlesex	■		■	■	■	■	■	■	■	Six Projects: Two in Operation
Monmouth		■	■	■	■					Pending Required Information
Morris		■	■	■	■					
Passaic		■	■	■	■					Disapproved by Coordinating Comm.
Somerset		■	■	■	■					
Union		■	■	■	■					Disapproved by Coordinating Comm.
N. Y.										
Dutchess	C W A	■	■	■	■		■			Withdrawn by Sponsor
Nassau	C W A	■	■	■	■					
Orange	■		■	■	■		■			Pending Required Information
Putnam	■	■	■	■	■		■			Pending Required Information
Rockland	■	■	■	■	■		■			
Suffolk		■								Being Set-up in District Office
Westchester	■		■	■	■		■			
New York City (5 COUNTIES)	■		■	■	■	■	■	■	■	
CONN.										
Fairfield	■		■	■	■	■	■	■	■	

[a] Regional Plan Association

at Washington. This was done but the difficulty was never effectively overcome. With the aid of the National Resources Committee I hope it soon will be.

Probably the most serious obstacle has been the large number of steps necessary between drafting a project and putting it into operation. The following list of requirements is probably not complete but will serve as an illustration:

1. Official sponsorship and a financial contribution by the sponsor.
2. Approval by the local WPA office.
3. Approval by the state WPA office, where it is referred to the state coordinator of statistical and professional projects.
4. Approval in Washington by the Coordinating Committee of the Central Statistical Board and WPA.
5. Approval by the National Resources Committee, to which some but not all planning projects are referred by the Coordinating Committee.
6. Final approval by federal WPA.
7. Presidential approval.
8. Approval by the Comptroller General and allocation of funds.
9. Back to the state WPA, where the administrator finds himself swamped with approval projects in excess of available funds.
10. Back to the local WPA office after state funds have been allotted.
11. Assignment of men to the sponsor for operation of the project.

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FAIRVIEW VILLAGE, NEAR CAMDEN, N.J., A FEDERAL WAR-INDUSTRY DEVELOPMENT

If these eleven steps only were necessary for each project, the situation would not be altogether impossible, but after reaching Washington some projects are sent back to the sponsor with a request for additional information, and have to start out all over again. On the return trip the same tedious route has to be followed, with perhaps other interruptions.

This complicated procedure was established to provide a thorough check on the suitability of projects and to ensure that nothing is approved which is not desirable or which duplicates another project. But in this attempt to centralize all final decisions in Washington, I believe that much speed and efficiency have been sacrificed. If the selection of suitable planning projects in each of the states had been left to the state planning boards, with the cooperation of regional planning organizations where they existed, I believe a far simpler and more effective system could have been established.

OFFICIALS OF MUNICIPAL SUBDIVISIONS SOMETIMES REMISS

All obstacles and delays cannot, however, be laid to WPA machinery, for there have also been serious obstacles resulting from the lack of interest and understanding of local officials. The Regional Plan Association, for example, has made strenuous efforts to have county planning boards set up throughout the New York Metropolitan Region and to have such boards sponsor projects drawn up in accordance with the association's standards. In many cases the county officials have been very reluctant to establish such boards, and the expedient was finally adopted of creating committees for planning studies in such counties, made up of officials and leading citizens. These groups have in many cases drafted and sponsored planning projects and have been successful in getting official county endorsement.

As a result, county planning projects have been submitted to the WPA in all but two of the 17 suburban counties in the New York region. One of these withdrew its project because of inability to find suitable personnel on the work relief rolls. To bring about these results, an intensive field campaign by the Regional Plan Association was required, lasting over a year. This indicates the amount of educational work necessary to get official backing of planning projects and to get them drafted along reasonable lines.

Undoubtedly there has been a lot of careless and ambiguous work in preparing project applications, and I do not mean to imply that the return of applications to their sponsors for correction was not in many cases justified. I do believe, however, that in many other cases it was the result of needlessly involved regulations, lack of understanding on the part of individual members of the reviewing staffs, and over-centralization of authority.

PLANNING PROJECTS CLASSED AS STATISTICAL

The Federal Coordinating Committee has ruled that planning projects are statistical in character, and has set up special requirements for data to be submitted therewith. The special information required for such projects was apparently aimed primarily to cover real property inventories, traffic censuses, and other complicated field surveys. The Regional Plan Association pointed out both to the Coordinating Committee and to the National Resources Committee that planning deals only incidentally with statistics and that many of the questions asked did not apply to planning projects. Nevertheless, the Coordinating Committee ruled that a planning project is a statistical project and that therefore every question must be answered, not only for the project as a whole but for each of the items covered in its program. As a result, practically every planning subject submitted up to the time of the ruling was returned.

Planning projects should be defined as a separate group, and separate instructions should be drawn up for their preparation and approval. In line with this, the Regional Plan Association urged upon the federal emergency relief administration that manuals of procedure

STATION PLAZA AND APARTMENT TOWER, FOREST HILLS GARDENS, N.Y.

be issued by them for planning projects, and submitted drafts of such manuals—one for county planning and one for municipal planning. These were favorably received, but as WPA was then being organized, they were not acted upon and were somehow lost in the shuffle. If work relief is to be continued through another year, I hope that this situation can be straightened out.

One of the steps taken by the Regional Plan Association to promote the coordination of county planning projects was to prepare standard legends for base maps, to be used for presenting planning data. The field work included drafting tentative planning projects to fit each county where such projects were under consideration. These drafts were turned over to the local planning board as a starting point in its deliberations. The association also supplied sample forms and schedules for the collection and presentation of data.

In no case has a county organization arbitrarily taken this material and submitted it, but rather has used it as a starting point in preparing the application and adapted it to its own use. As a result, the county planning projects in the New York region will be along mutually similar lines. Base maps that are being prepared will be similar in scale and symbols; surveys of existing land uses will be broken down into similar classifications. Thus there will be a real coordination in county planning which should make the results much more useful to the regional and state planning boards in New York and New Jersey than would otherwise be the case.

An important part of the association's activity is to interest county officials in the establishment of planning as part of the county's permanent organization, with adequate financial support. It is also hoped that the work relief officials can be convinced of the desirability of planning projects, both to promote better development of the various areas and to supply information for judging the merit of construction projects advanced for consideration either by WPA or PWA.

SOME DISCOURAGING EXPERIENCES

Some of the discouraging experiences which have been brought to my attention may help to illustrate the handicaps under which work relief planning has labored.

A study of government and department statistics in the municipalities of a county was being made by an official planning commission under the local emergency relief administration. Statistical data showing the costs of various departmental services had been completed for about 30 of the 70 municipalities when WPA came into existence. Application to WPA for funds to complete the project was disapproved because it overlapped a statistical study which the state planning board intended to make but which had not yet been started. The simplest way would have been to exclude this county from the state project.

Any projects involving a house-to-house canvass are being arbitrarily ruled out, although a year ago real property inventories made in this way were being carried on extensively and municipalities were urged to apply for such projects.

Instructions issued jointly by the National Resources Committee and WPA for setting up state planning projects as part of the nation-wide study, specified that they should be submitted at once on WPA Form 301 and placed in operation at the earliest possible date. In the case of a certain state, final approval by the state office of WPA was granted on November 29, 1935, and the staff, previously under the local emergency relief administration, was transferred to WPA on December 1. On December 18 the state WPA office advised the planning board that they had received a WPA bulletin dated November 30, advising that all such state planning projects must be submitted on a new WPA Form 330, which the state office had never received and had known nothing about. As a result no new men could be assigned and things were at a standstill until such time as it was possible to cut the red tape.

CONCLUSIONS

The conclusions to be drawn may be considered in three groups, classified according to the officials and individuals affected.

As regards WPA and other relief officials:

1. Special instructions and procedures are needed to cover planning projects.
2. The National Resources Committee should be depended upon for intensive review and coordination of state planning projects.
3. State planning boards and regional planning organizations should be used for the intensive review and coordination of county and municipal planning projects.
4. The review of planning projects by the federal offices should be primarily to ensure a balanced program from the point of view of expenditure and supply of the different types and amounts of employment needed. It should not attempt to review minor details.

As regards state, county, and municipal local officials:

1. Planning projects are most effective when under the supervision of official planning boards with a regular staff and funds.
2. Planning projects can complete much preliminary and tedious fact-finding work invaluable in the later preparation of comprehensive plans.

As regards the general public:

1. Planning is a sound investment of man power and money, as it shows how to prevent the needless waste of unplanned development and makes possible a progressive and useful public works program and the preservation of existing values.
2. The establishment of official planning boards and the appropriation of funds to take care of routine work and expert supervision will establish planning on a permanent and stable basis, and will guarantee effective results from work relief planning projects.

Reports of Society Committees

Presented at the Annual Meeting of the Society in New York on January 15, 1936

Committee on Salaries

By E. P. GOODRICH, *Chairman*

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

DURING the year 1935, the activities of the Committee on Salaries shifted from the field of welfare work, which had been occupying part of its efforts, back to salary investigations exclusively. These consisted of:

1. Collection of data, as to:
   (*a*) Engineers' unemployment ratio
   (*b*) Actual salary rates received when employed
2. Analysis of salary data to determine:
   (*a*) Comparisons with previous years
   (*b*) Salary increase increments and dominant rates in actual use
   (*c*) Relation between salary and experience
   (*d*) Relation between salary and various economic factors
3. Assistance, by furnishing salary data, to:
   (*a*) Individuals and groups of engineers
   (*b*) Governmental agencies

During the year, the total salary inquiries and follow-up letters and telegrams numbered 3,580.

Unemployment data concerning the graduates of 231 colleges and universities located in 40 states are combined in Table I (extracted from *Journal of Higher Education*, Vol. VI, No. 7, Oct. 1935).

For the nation as a whole, of the class of 1934, 63 per cent of the graduates in education secured teaching positions, 66 per cent of the graduates in engineering obtained employment, 81 per cent of the graduates in business training got jobs, and practically all the graduates in medicine continued their advanced preparation for their profession (*Journal of Higher Education*).

In 1934 experiences of some University of Michigan graduates are shown in Table II (extracted from *Michigan Alumnus Quarterly Review*, Winter, 1935). About 86 per cent of the employed lawyers reported that they were working as lawyers. The corresponding percentage for dentists was 90.

Of the engineers only 50 per cent of those employed reported that they were engaged in engineering. The next largest group, 8.5 per cent, were doing clerical work; the skilled trades, unskilled labor, work as foreman or shop superintendent, and selling came next in order, accounting for 23 per cent in all (*Michigan Alumnus Quarterly Review*, Winter, 1935).

More than 85 per cent of the employed business administration school group were engaged in business occupations, but the one reporting highest earnings was a superintendent of highway construction, and the one with lowest earnings was farming (*Michigan Alumnus Quarterly Review*, Winter, 1935).

Salary experiences for some of these groups were as shown in Table III (*Michigan Alumnus Quarterly Review*, Winter, 1935).

From original sources, the committee learned that during 1935, 43 state highway departments paid $36,663,051 to 19,588 engineers on their rolls. The states for which data were not furnished in time for this report were Georgia, Louisiana, Maryland, Ohio, and Tennessee.

Some relative statistics for 1935 and 1934, as compared with 1929, are shown in Table IV. As to the pay of the top men in the highway departments of 43 states in 1935, ten were higher than in 1929, seven were the same as in 1929, ten were higher than in 1934, and fifteen were the same as in 1934.

In 608 counties heard from throughout the United States, 169 employed no engineer. In 434 counties the 1934 salary ranged from $5,000 to $200, with an average of $2,187. Based on meager data for county engineers' salaries for 1935 compared with 1934, 10 per cent were lower, 47 per cent were the same, and 43 per cent were raised. Other data on these inquiries are given in Tables V and VI.

In one instance it was stated that the engineer received $8.00 per day when on regular road supervisory work and

TABLE I. EMPLOYMENT STATUS OF 1934 COLLEGE GRADUATES

Geographic Divisions of States	Total No. of Graduates	Percentage Distribution of Graduates				
		Full-time Employment	Part-time Employment	No Employment Whatever	Taking Graduate or Professional School Courses	Unaccounted for
(1)	(2)	(3)	(4)	(5)	(6)	(7)
MEN GRADUATES						
New England	1,823	42.7	9.3	22.8	23.8	1.4
Middle Atlantic	2,616	50.5	6.2	16.6	22.1	4.7
North Central	4,417	56.2	12.7	10.5	16.3	4.2
Southern	2,235	64.5	8.6	10.1	15.3	1.5
Western	930	63.8	7.1	8.7	14.4	6.0
United States	12,021	55.1	9.6	13.5	18.4	3.5
WOMEN GRADUATES						
New England	1,207	44.1	7.9	21.8	20.8	5.4
Middle Atlantic	1,493	50.3	7.3	22.1	15.2	5.2
North Central	3,156	57.9	12.0	16.6	9.2	4.3
Southern	2,687	71.3	4.6	12.9	7.6	3.6
Western	605	51.1	6.6	25.7	14.7	2.0
United States	9,148	58.3	8.2	17.7	11.6	4.2

TABLE II. UNEMPLOYMENT STATISTICS FOR 1934 BY OCCUPATIONAL GROUPS

University of Michigan, Classes of 1932 and 1933 Combined

Group	Percentage of Unemployment	Group	Percentage of Unemployment
Forestry	0	Music	29
Law	5	Architecture	33
Dentistry	5	Literature	40
Business Administration	9	Holders of master's degrees	15
Engineering	16	Holders of Ph.D.'s	10
Teaching	20		

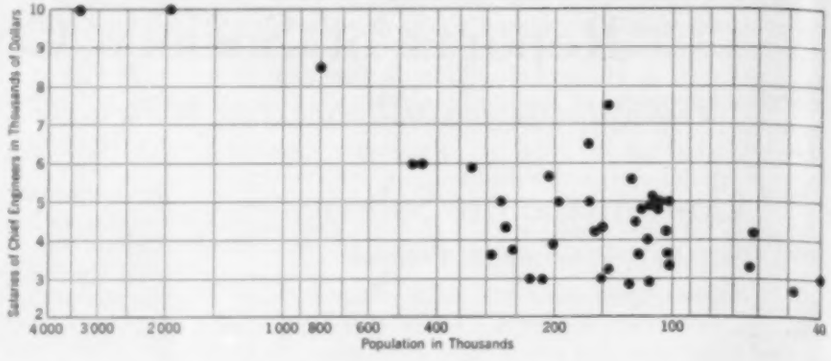
TABLE III. MEDIAN RANGE OF COMPENSATION FOR 1934, UNIVERSITY OF MICHIGAN

Classes of 1932 and 1933

Teachers	$751 to 1,000	Business	1,496 average
Literature, etc.	1,001 to 1,250	Music	1,000 average
Engineering:		Forestry	2,132 average
Class of 1932	1,250 average	Holders of master's degrees:	
Class of 1933	1,001 to 1,250	Men, class of 1932	1,501 to 1,750
Law:		Class of 1933	1,251 to 1,500
Class of 1932	1,251 to 1,500	Holders of Ph.D's	2,001 to 2,500
Class of 1933	1,001 to 1,250		

FIG. 1. RELATION OF POPULATIONS OF CITIES TO THE SALARIES PAID THEIR CHIEF ENGINEERS

Data Are for the Year 1930, and Are Plotted on a Logarithmic Scale Horizontally



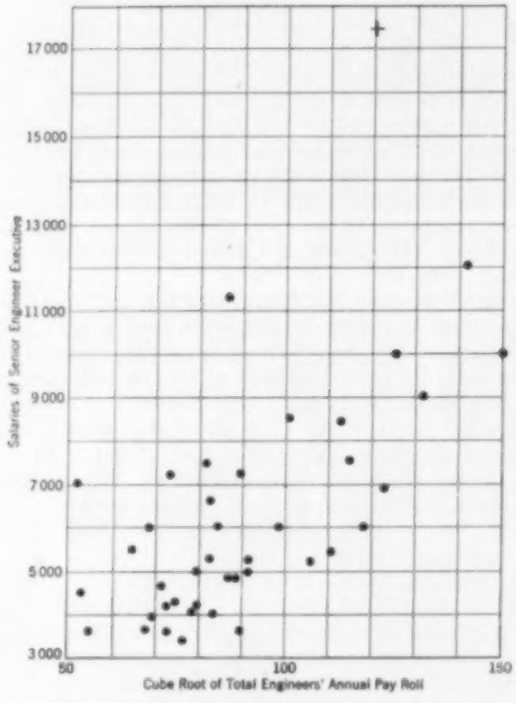


FIG. 2. SALARIES OF SENIOR ENGINEER EXECUTIVES PLOTTED AGAINST CUBE ROOT OF TOTAL SALARIES OF ENGINEERS IN 42 STATES, 1935

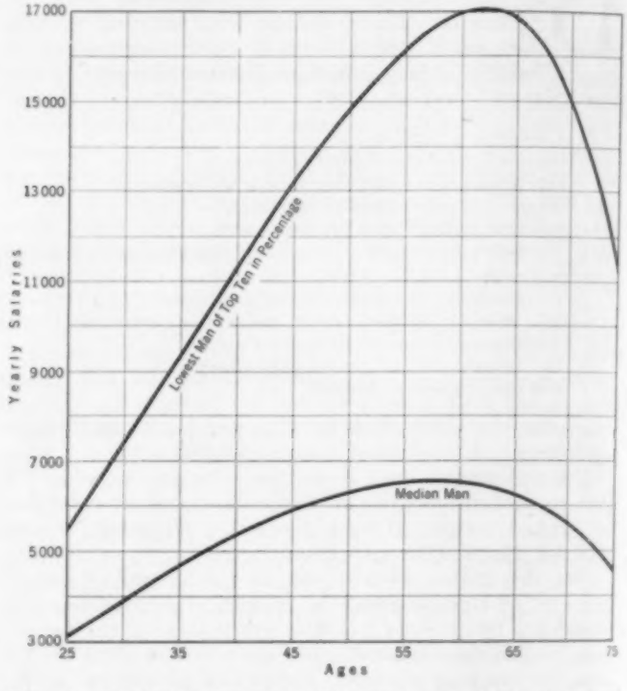


FIG. 4. RELATION BETWEEN SALARIES AND AGES OF CHIEF ENGINEERS

8,500 Total Position-Years, 1910–1930

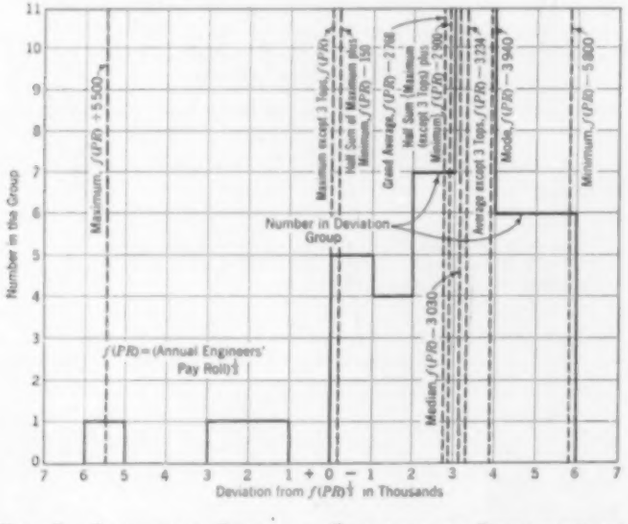

Number in the Group
11
10
9
8
7
6
5
4
3
2
1
0
Maximum, /(PD) + 5 500
Maximum except 3 Tops, /(PD)
Half Sum of Maximum and Minimum, /(PD) — 150
Grand Average, /(PD) — 270
Half Sum (Maximum except 3 Tops) plus Minimum, /(PD) — 1 980
Number in Deviation Group
Median, /(PD) — 3 030
Average except 3 Tops, /(PD) — 3 124
Mode, /(PD) — 3 940
Minimum, /(PD) — 5 800
/(PD) = (Annual Engineers' Pay Roll)½
7 6 5 4 3 2 1 + 0 — 1 2 3 4 5 6 7
Deviation from /(PD)½ in Thousands

FIG. 3. STATISTICAL STUDY OF GROUPING OF DEVIATIONS OF SALARIES OF ENGINEER EXECUTIVES FROM LINE OF BEST FIT

Data from 42 States in 1935

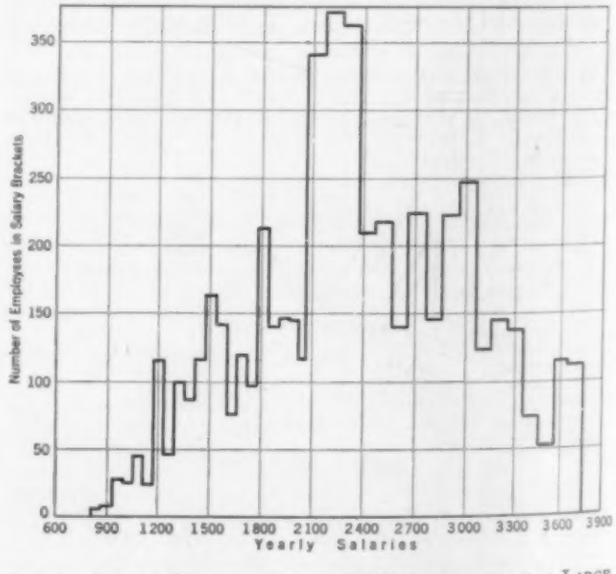


FIG. 5. SALARY DISTRIBUTION OF 5,200 ENGINEERS IN A LARGE NUMBER OF RAILROADS, 1928

$7.00 per day while surveying. This differentiation raises several mental queries.

A résumé of the data collected by the committee as to salary ranges during the years 1934 and 1935 for men employed in different branches of the profession is given in Table VII.

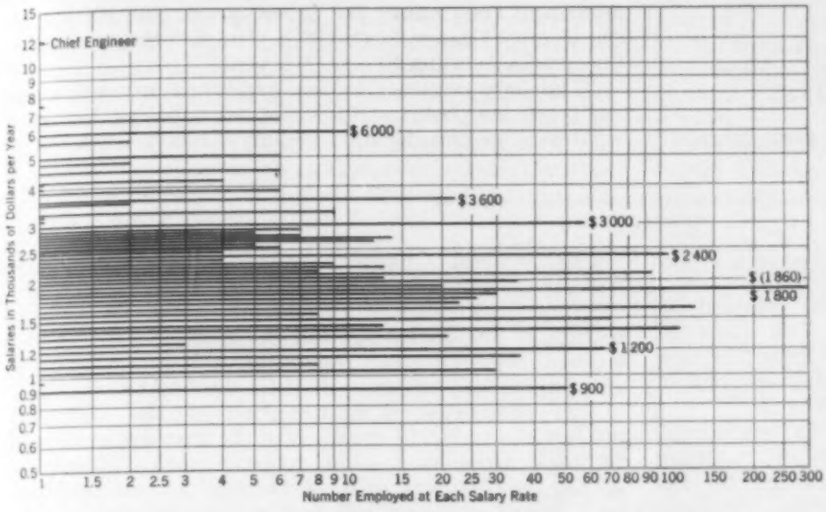


FIG. 6. DISTRIBUTION OF 1,400 SALARIES OF ENGINEERS IN ONE ORGANIZATION, PLOTTED LOGARITHMETICALLY

Beginning July 1, 1932, federal employees were subjected to a salary reduction under the Economy Act of June 30, 1932. The periods during which salary reductions were applied, were as follows:

July 1, 1932, to March 31, 1933	8½ per cent (with furlough)
April 1, 1933, to January 31, 1932	15 per cent (without furlough)
February 1, 1932, to June 30, 1935	10 per cent (without furlough)

Salaries were restored to 100 per cent April 1, 1935

The act of February 13, 1935, provided that after March 31, 1935, there should be no reduction.

Among the correlation studies made was one (Fig. 1) which showed the relation between the salaries of the city engineers or of engineer executive heads of large city departments and the populations of the cities (1930). Another study (Fig. 2) compared the salary of the chief engineer of the state highway department or that of the highest-paid engineer executive, with the total engineers' annual payroll. A statistical analysis was made of the several salaries compared with the trend line of best fit, and the formulas derived for several commonly used statistical factors are as shown in Fig. 3. In addition, the standard deviation and standard error were determined. Both of these statistical measures were found to indicate that a good correlation exists when the three largest salaries are omitted.

Data were also collected and studied with respect to the correlation between age and salary of over 8,500 examples of chief engineers, during the period between 1910 and 1930. The results are shown in Fig. 4.

Other studies were also made to show the correlations of the salaries of the chief engineering executives of state highway departments with state population, value of work in hand (1929 data) total taxes paid in state, per capita state wealth, relative "living levels" (recomputed data from the Wharton School, University of Pennsylvania), and income per capitaby states (Brookings Institute data).

The state factors for the "plane of living" (weighted for county populations) were computed from data provided by the Wharton School and are shown in Table VIII.

In connection with studies looking to the eventual formulation of practicable working salary classifications, many collections of actual salary data were analyzed. Two such graphical studies are shown in Figs. 5 and 6.

The committee is cooperating in a salary study of engineering positions in all municipalities in New York State. Approximately 75 replies were received up to the end of the year 1935.

TABLE IV. INDEX NUMBERS FOR ENGINEERS, BASED ON 1929 FIGURES, FROM 41 STATE HIGHWAY DEPARTMENTS

ITEM	1935	1934	1929
Total engineers' payrolls	130	113	100
Total number employed	136	129	100
Pay of top man	87	82	100
Lowest rate of pay	101	99	100

TABLE V. PERCENTAGE OF COUNTIES WHICH REPLIED BY STATES

STATE	PERCENTAGE REPLIES	STATE	PERCENTAGE REPLIES
Arizona	69	Virginia	32
Oregon	50	Washington	29
Kansas	49	Oklahoma	28
New York	46	Ohio	27
Minnesota	42	Montana	25
Utah	37		
Delaware	33	General average	22

TABLE VI. SALARIES OF TWO TYPICAL COUNTY ENGINEERS IN DIFFERENT STATES

YEAR	ENGINEER A	ENGINEER B
1933	$2,200	$2,000
1934	2,400	2,133
1935	2,500	2,200
1936	3,000	2,400

TABLE VII. CIVIL ENGINEER SALARY RANGES, 1934 AND 1935, BY POSITIONS

POSITION	SALARIES
County engineers	$200– 5,000
City engineers and chief engineers of large city departments	2,700–25,000
State highway chief engineers	3,380–17,500
City managers who were engineers	1,800–20,000
Railroad chief engineers	3,600–18,000
Public utilities chief engineers	3,000–13,500
Consulting engineers	0–20,000
Executives who were engineers	up to 75,000

TABLE VIII. FACTORS FOR PLANE OF LIVING, BY STATES
Based on Total United States = 100

Alabama	27.4	Nebraska	117.0
Arizona	57.7	Nevada	108.1
Arkansas	29.4	New Hampshire	110.7
California	151.6	New Jersey	134.1
Colorado	100.6	New Mexico	34.7
Connecticut	137.4	New York	151.3
Delaware	104.8	North Carolina	28.2
District of Columbia	193.0	North Dakota	73.0
Florida	51.2	Ohio	114.5
Georgia	31.9	Oklahoma	59.6
Idaho	75.5	Oregon	112.4
Illinois	145.6	Pennsylvania	107.4
Indiana	100.8	Rhode Island	121.3
Iowa	117.6	South Carolina	21.1
Kansas	104.9	South Dakota	90.5
Kentucky	47.8	Tennessee	43.4
Louisiana	40.1	Texas	58.6
Maine	95.4	Utah	85.7
Maryland	91.8	Vermont	106.2
Massachusetts	136.4	Virginia	46.4
Michigan	113.5	Washington	122.8
Minnesota	108.2	West Virginia	53.0
Mississippi	21.1	Wisconsin	118.9
Missouri	101.4	Wyoming	94.7
Montana	83.8		

During 1935 the committee furnished data to assist in establishing proper salaries for the following typical cases:

City engineer
Executive engineer on very large project
State highway bridge engineering division
Lower grades (for Federal Resettlement Administration)
Complete engineering organization for a small city
Complete engineering organization for a small state
A private holding company
A large subway engineer group

Among many examples of the "human interest" features which came to the attention of the committee, the following are of note:

"John Doe was Highway Supt. in 1933 to 1934. He got $210.00 per month and had to haul the commissioners from place to place. This is the only Engineer we had hired in our county."

"We wish to advise that we pay our engineer and fireman at the County Jail $1,000 a year and the one at the County Garage $1,080.00 a year and the one at the County Sanatorium $1,620.00 a year."

"The only engineer in my employ is my wife—she engineers our home. She's not on a salary but gets whatever she can dig up. Deputy County Clerk."

COMMITTEE ON STUDENT CHAPTERS

THE COMMITTEE on Student Chapters retained its existing general plan of organization, Col. Glen E. Edgerton of the U. S. Army Engineer Corps, the new member to replace Col. T. A. Leisen, being assigned to supervise the Chapters of the western district.

So far as information has come to the committee, the Student Chapters are in good condition. Certain Chapters which were somewhat demoralized by the depression and by other circumstances have improved in vitality and enterprise. For the past academic year, no Chapters are delinquent in payment of dues—a definitely encouraging record. If the Chapters were graded, about half would be classed as "A," and most of the remainder would be "B." Between 5 and 10 per cent might be classed as "Poor."

Evaluation of the condition of the Chapters has depended principally upon written reports and correspondence. It is hoped that the visits of the Field Secretary will not only permit a clearer picture of the situation in the Chapters but will add the proper stimulus where necessary to bring them all into satisfactory condition.

In order to give recognition to meritorious Chapters, each member of the committee will select annually three Chapters in his district on the basis of program, annual report, and general effectiveness, and the committee recommends these Chapters to receive a "letter of commendation" from the President of the Society. Likewise, the committee recommends that a letter recognizing conspicuous progress should be sent over the signature of the President to such Chapters as may show marked advance during the year. (The list of Chapters so recognized and commended appears in the Society Affairs section of this issue.)

Believing that some uniformity in objectives and operations among the Chapters is desirable, the committee prepared the manuscript for a "Manual for Student Chapters of Am. Soc. C.E." Such a manual reaching the student at the most receptive stage offers a favorable opportunity to present advantageously the ideals of the profession and of the Society. The Manual was issued early in December. The committee will appreciate the receipt of constructive criticisms and suggestions for the improvement of future editions of this Manual.

The committee undertook during the year to stimulate the holding of Student Chapter conferences. It is the ultimate hope of the committee that practically all of the Chapters may be able to participate in these regional group conferences. In this field, the Chapters in the southern district have been particularly active.

The Student Chapter conference at Birmingham, Ala., at the time of the Fall Meeting of the Society, was the first conference since October 1932. A notable feature of the gathering was the ease with which the student representatives addressed the group, and the earnestness and sincerity of their discussions.

The committee is appreciative of the continued interest shown by the members of the Board as evidenced by their attendance. The conference idea is growing among the Chapters, and the committee feels confident that Board members will lose no opportunity to lend their personal support to the movement whenever they can.

Several of the Chapters have reported that speakers from the profession who have appeared before the Chapters have provided dull programs, and have therefore urged that only good speakers be sent to them. Speakers called upon for Student Chapters would do well to personalize their remarks as much as practicable instead of discussing abstract principles. They should enable the students to visualize what they or their helpers actually did in the circumstances described in the address.

The question of prizes for special student papers was discussed. The opinion prevailed that where prizes for student papers are offered by Local Sections or by other Society agencies, the conditions of award should be formulated with a view to a minimum of interference with the regular instructional program of the school involved.

Respectfully submitted,

C. C. WILLIAMS, *Chairman*

G. E. Edgerton — R. L. McCormick
H. W. Hanly — T. J. Wilkerson

REPORT OF COMMITTEE ON EARTHS AND FOUNDATIONS

THE COMMITTEE on Earths and Foundations has been active since it was first constituted about seven years ago. Its membership at present consists of Lazarus White, chairman; George E. Beggs, M. L. Enger, R. J. Fogg, Glennon Gilboy, Harry T. Immerman, D. P. Krynine, F. A. Marston, George Paaswell, and Charles Terzaghi. It thanks the Society and the Engineering Foundation for their continued support, as it finds its work continually expanding. The committee's principal aim has been to foster research work in a wide field, and it has been fortunate in aiding this work at various centers such as Vienna; Cambridge,

Mass.; Yale University; Columbia University; and the University of Minnesota. By a little timely help, financially and otherwise, it has been instrumental in creating centers of research and has kept active work which might otherwise have been dropped because of the very limited appropriations for laboratory assistance not only at university laboratories but in the field where the work is being applied directly.

Much more arduous than the above is the task of making available for the practicing engineer the results of the research work the committee has fostered. Reports from several sources are now at hand and are being put into shape for publication by the committee in the reports of the Society. The committee hopes to present the closing discussion of its first report in the very near future; and, later, reports on lateral earth pressures and a report on earth dams and the basic hydraulic principles which determine their safety—this work was transferred from another committee and assigned to it. The committee is fortunate in having at hand a wealth of material from the hydraulic laboratories at Minnesota and Iowa, and from the contractors engaged in the very extensive Mississippi River improvement.

The committee finds that soil mechanics has been widely accepted as an aid to the design of structures on earth and of earth, particularly in the field of earth dams. In the Muskingum project, a large laboratory has been installed under the direction of one of the members of this committee. Here the principles of the hydraulic-fill dam, as developed by Professor Gilboy, are applied. In southern California, soil mechanics have been applied to the construction of filled embankment for dams, and field controls have been developed to a high degree under the direction of R. R. Proctor.

SPECIAL COMMITTEE ON HYDRAULIC RESEARCH

THIS SPECIAL COMMITTEE on Hydraulic Research held its first meeting at the U. S. Waterways Experiment station, Vicksburg, Miss., April 1 and 2, 1935. A rather ambitious program was outlined and members have willingly and enthusiastically accepted the assignments made. The work outlined and progress to date on each assignment are as follows:

Letter Symbols for Model Studies. A set of letter symbols that may be adopted as standard for model work is being prepared by a subcommittee. The symbols for hydraulics adopted by the American Standards Association will be adhered to as closely as possible, this being an expansion and elaboration of those standards. The list is in the making mostly by correspondence.

Conformity of Model to Prototype. The proof of the value of model studies lies in the correspondence of model and prototype behavior. In addition to the data appearing in "Hydraulic Laboratory Results and Their Verification in Nature" (PROCEEDINGS for January 1935, page 57) by Herbert D. Vogel, Assoc. M. Am. Soc. C.E., and the discussion that followed, a subcommittee is gathering data, and particularly is urging that facilities for testing be incorporated in hydraulic structures at the time they are constructed in order that their behavior can be correlated with the model studies that preceded.

Research Problems. In this field the committee is working along two lines:

1. To supply problems for hydraulic research to students and others, that are suited to the investigators' ability and facilities, and to act in an advisory capacity regarding them.
2. Certain fundamental lines of research are being assigned to a few directors of laboratories who will be designated as cooperating members. It is expected that a small allotment of funds will be secured for apparatus required for each assignment.

The research is expected to be confined to basic principles in which the physical phenomena will be stressed. The assignments that have been accepted to date are:

"Traveling Waves on Steep Slopes," accepted by Harold Thomas, M. Am. Soc. C.E., Professor of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

"Curves in Open Channels," assignment accepted by C. A. Mockmore, M. Am. Soc. C.E., Head, Department of Civil Engineering, Oregon State College, Corvallis, Ore.

"Phenomena of Intersecting Streams," assignment accepted by M. P. O'Brien, M. Am. Soc. C.E., Associate Professor of Mechanical Engineering, University of California, Berkeley.

"The Conversion of Kinetic to Potential Energy," assignment accepted by F. T. Mavis, M. Am. Soc. C.E., Associate Director in Charge of Hydraulic Laboratory, University of Iowa, Iowa City.

"Sedimentation at the Confluence of Rivers," assignment accepted by Lorenz G. Straub, M. Am. Soc. C.E., Professor of Hydraulics, University of Minnesota, Minneapolis.

Negotiations are under way with others for a few additional assignments bearing on the physical laws of hydraulic phenomena of which we have but little knowledge.

Manual of Laboratory Practice. The committee is preparing an up-to-date manual on model studies to aid in securing greater uniformity in the method of approach to the solutions of practical problems by model studies.

It has been found by recent experiences that a hydraulic laboratory where model studies can be made is almost an indispensable tool for the proper design of large and intricate hydraulic works such as those of TVA, Bonneville, Grand Coulee, Fort Peck, and Boulder. Many times the cost of laboratory studies is saved, the schedule of completion is materially advanced and, what is more important, an atmosphere of security is engendered whenever important calculations can be checked by model behavior.

Respectfully submitted,

J. C. STEVENS, *Chairman*
HERBERT D. VOGEL, *Secretary*

Clarence E. Bardsley — Lorenz G. Straub
E. W. Lane — Chilton A. Wright

COMMITTEE ON FLOOD PROTECTION DATA

THE REPORT of the Committee on Flood Protection Data, which was submitted by Gerard H. Matthes, chairman, was published in full in the February 1936 issue of PROCEEDINGS. The other members of the committee are Frederick H. Fowler, Robert E. Horton, Ivan E. Houk, C. W. Kutz, Charles W. Sherman, and Daniel C. Walser.

Recent Advances in Sanitary Design

Innovations in Design and Equipment of Sludge Digestion Tanks and Aeration Channels

RAPID progress in the technique of sewage treatment can be attributed largely to the sanitary engineer's active interest in research and to his willingness to give new features of design a thorough tryout in full-size plants. In California, for example, studies of the operating characteristics of existing treatment plants led directly to the construction of a multiple-stage digestion tank which, it was found, would reduce the organic content of the influent by 46 per cent in a digestion period of only 10 days. For more than two years, a thorough study of all phases of the operation of this plant has been in progress. The installation is described and the study reviewed in the first of the following articles. The second article, summing up current practice in the design of aeration tanks for activated sludge plants, illustrates again the progress that is resulting from experimentation. New improvements include the use of diffuser plates of high permeability, and the combined use of mechanical agitators and diffusion equipment. The possibility of increasing the ratio of width to depth of tank is under investigation and seems promising. These articles are abstracts of comprehensive papers presented before the Sanitary Engineering Division on January 16, 1936. It is impossible here to cover more than the high spots of either manuscript.

Multiple-Stage Sludge Digestion

By A. M. RAWN, M. AM. SOC. C.E.
A. PERRY BANTA, ASSOC. M. AM. SOC. C.E., *and* RICHARD POMEROY
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IN July 1931, the Los Angeles County Sanitation Districts placed in operation at their joint disposal plant near Harbor City, two batteries of multiple-stage digestion tanks. In this plant the main departure from conventional design and operation is the use made of the principle of gravimetric segregation. Digesting sludge particles tend to be held in suspension by adhering gas, but as digestion proceeds, the particles sink. The tanks are so designed that the lower strata automatically pass ahead to successively lower tanks, while the upper, more active strata lag. The capacity is thus more fully utilized for its intended purpose.

Each battery is rectangular in plan, topped with a concrete cover, and is 56 ft in width and 150 ft in length, with an effective depth of about 15 ft (Fig. 1). Three transverse walls divide each battery into four rectangular tanks, each 56 by 37.5 ft in plan, and each tank is equipped with two longitudinal baffle walls extending from within a foot of the tank bottom to the tank cover, dividing it into three bays of equal capacity. The bottom of the battery has a slope of 1 to 12, so that the sludge surfaces of successive tanks differ by about 3 ft. Each tank is equipped with a hopper at its lower end.

In operation, primary and activated sludges plus approximately 20 per cent, by volume, of digested sludge are introduced into the two outer bays of Tank 1 in either of the batteries, and the temperature of the mass is raised to approximately 85 F. To reach the central bay of Tank 1, solids must sink to the bottom and pass under the baffle walls. To reach the discharge riser pipes, leading from Tank 1 to the two outer bays in Tank 2, solids must accumulate in the hopper at the lower end of the center bay in Tank 1. Thus a process of gravimetric selection is operative in the flow of the sludge, and this selection is repeated in each successive tank until the sludge is discharged into the storage well.

An open pit has been constructed adjacent to the digestion tanks which, with a capacity roughly equal to the tanks themselves, serves as a balancing reservoir during poor drying weather, promotes removal of supernatant liquor, and incidentally increases the detection period.

In 1933 the tanks, which had been designed for a detention period of about 25 days, were heavily overloaded, yet good digestion results were obtained despite a detention period approximating only 10 days. Since April of 1933 a detailed study of the performance of the tanks has been in progress. Some

THE JOINT DISPOSAL PLANT OF THE LOS ANGELES COUNTY SANITATION DISTRICTS
Beyond the Sludge-Drying Beds Is the Main Sewage Treatment Plant, Which Includes, from Left to Right, Preliminary Sedimentation Tanks, Aeration Tanks, and Final Clarifiers. In the Right Background Can Be Seen the Multiple-Stage Digestion Tanks Described in This Article

of the results are discussed in the following paragraphs.

The average daily input of raw solids over the two-year period has been about 47,000 lb. During this time the net effective capacity of the tanks was 89 per cent of the designed capacity, as the fourth tank in each battery was pumped down from time to time for volumetric measurement of sludge.

TIME OF PASSAGE OF SOLIDS VARIES

It was found that the time of passage of the sludge solids might be either more or less than that of the liquor, owing to the varying tendency of the solids to remain in the upper part of the tanks or to settle relatively rapidly, and to the removal of supernatant liquor from the third tank of each battery.

After some months of operation, a thick scum layer formed in the first three tanks. The high solids content of this layer, and the presence in it of match sticks, hair, and bits of rubber, suggested that the scum layer might be largely made up of semi-permanent, indigestible matter, and might greatly reduce the effective capacity of the tanks. Analysis revealed, however, that more than 60 per cent by weight of the dry screenings from this scum consisted of organic matter. Moreover, the rate of gas production from scum samples was much in excess of the average rate for any of the tanks as a whole. These results show that in spite of the accumulation of semi-permanent matter, there was nevertheless enough digestible sludge temporarily retained in the scum to make it the seat of very active digestion.

As to the time of passage of solids, tests made in August 1933 showed it to be 2.02 times that of the liquor (new sludge plus seed). However, if allowance is made for the permanent material included in the scum, the time of passage is reduced to 1.25 times the fluid passage time, or 11.5 days. On the other hand, the May survey indicated that the solids were tending to settle and pass more rapidly from one tank to the next, resulting in a detention period of only 6.8 days. A factor of importance in the interpretation of the difference between the two surveys is the entraining effect resulting from the scum present in the August test. The mat of semi-permanent coarser material in the upper part of the tanks in all likelihood served to entrain and hold the solids of the sludge from the intertank discharge, and likewise to hold the solids carried up from the bottom by entrained gas.

Taking into account the fact that the seed sludge is already digested and has been through the tanks at least once, the average age of all solids leaving the tanks was 15.3 days in the August 1933 survey and 9.7 days in May 1933.

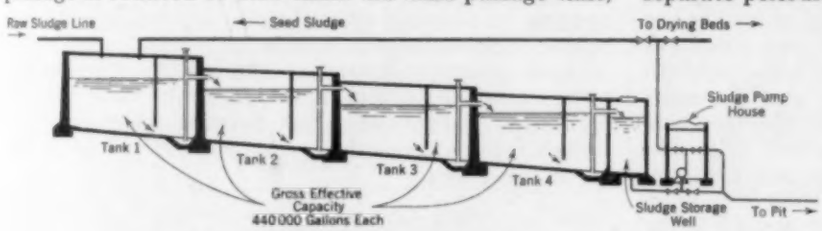
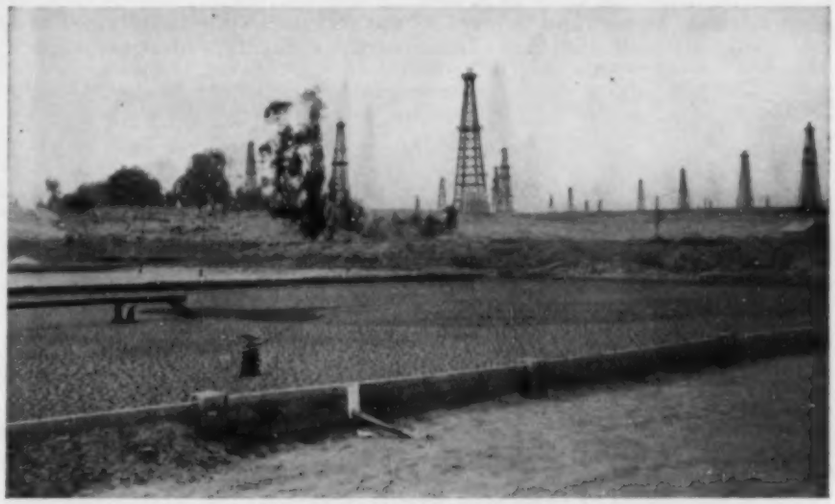


FIG. 1. SCHEMATIC DIAGRAM OF DIGESTION SYSTEM

The Baffles Shown Schematically as Transverse Are Actually Longitudinal

The design capacity of the tanks is 13.3 times the average volume of new sludge added daily, or 4.7 cu ft per lb of new solids added daily. The average reduction in organic matter effected by the tanks for the two years ending April 1935 was 46.4 per cent. In weight this equals 15,260 lb per day. During the second year of the tests, 75 per cent of the sludge from the tanks was pumped to the pit for an additional detention period of 27 days. Calculations showed an average reduction in the pit of 14 per cent of the organic matter added. Tanks and pit together therefore effected a 53.9 per cent reduction in organic matter. Of this total reduction, 83 per cent occurred in the tanks. The temperature in the pit is somewhat lower than in the tanks.



SLUDGE-DRYING BED WITH UNDERDRAINS

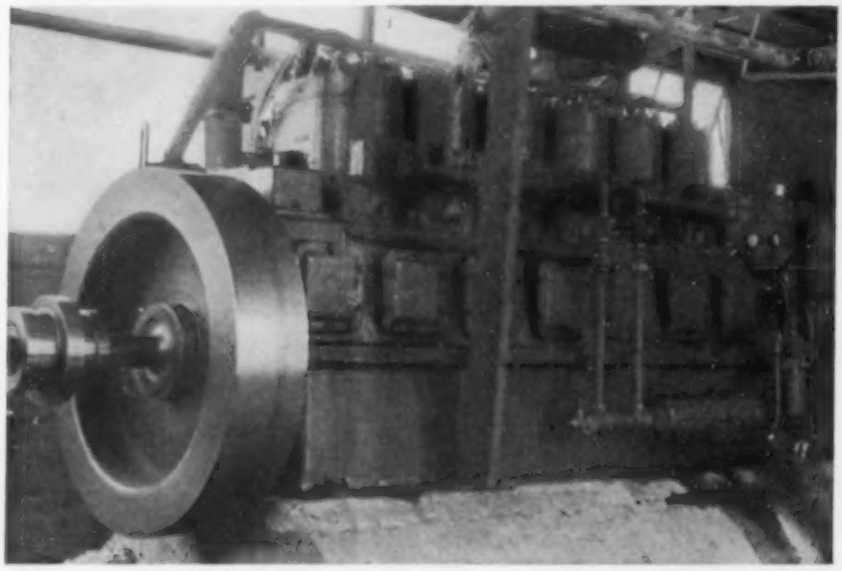
A 13-In. Charge from the Digestion Tanks Has Shrunk to a Depth of 5 In. in 45 Hours

PRODUCTION AND USE OF GAS

Gas measurements by stages were made over four separate periods during the first year of the tests. The total average daily production was 270,000 cu ft, of which 47 per cent was produced in the first stage. The weight of gas was 107 per cent of the weight of organic matter destroyed. If the CO_2, NH_3, and volatile acids lost from samples of new or digested sludge upon drying during analysis were taken into account, this figure would be still higher. About 50,000 cu ft of gas is burned per day in a water-heating boiler used to heat the digestion tanks. The gas is also used as fuel for a 200-hp engine driving a centrifugal pump used for pumping the plant effluent. At top speed the engine uses gas at the rate of 115,000 cu ft per day, or 24 cu ft per hp-hr. The gas is used in the engine without scrubbing or other treatment, and after eight months of continuous service, as of January 1936, has shown no tendency to corrode the engine parts and has presented no other unusual operating difficulties. The engine had been out of service for repairs and adjustment 0.57 per cent of the time.

After the sludge-heating boiler had been in operation for about eight months, difficulty was experienced from clogging of the flues. Plugs of hard grayish-white material, essentially ferrous sulfate, had formed near their

lower ends. Presumably the burning of the H_2S in the gas had produced SO_2, which dissolved in condensed water in the flues and changed to sulfuric acid. The acid dissolved iron from the pipes and carried the sulfate in solution down the flues to a point where the temperature was higher and where it was crystallized. The use of a forced draft has eliminated the difficulty, probably by preventing condensation of either water or sulfuric acid in the flues.



GAS FROM THE DIGESTION TANKS DRIVES THIS 200-HP ENGINE
The Gas Is Not Scrubbed or Treated in Any Way, and Has Shown No Tendency to Corrode the Engine Parts

The piping of the gas-collecting system has shown no deterioration. Concrete and metal work in the digestion tanks is in good condition except that in the fourth tank of each battery the concrete above the sludge line shows moderate surface deterioration. In these tanks some air occasionally becomes mixed with the gas, and probably oxidizes H_2S to H_2SO_4. The gas that diffuses out through small cracks in the concrete has caused detectable deterioration in a few places on the exterior of the tanks where the concrete is exposed to the air. The concrete of the tops of the tanks, covered with a coat of tar and 12 in. of soil, is apparently unaffected, but electrical conduits laid in the soil have in some places been practically destroyed. Free sulfur has been deposited on the surface of the soil in a few small areas. It is surprising to observe these effects from such a small percentage of H_2S in the gas (about 0.02 per cent).

EFFICIENCY OF HEATING COILS INCREASED BY CLEANING

The tanks are heated by means of 2-in. extra-heavy wrought-iron coils arranged vertically along the partition walls of one side of each of the first three tank compartments. Individual runs of pipe of each coil were placed in a vertical position to prevent the settlement of solids on the pipe. The coils of the first tank of each battery were designed to supply enough heat to raise the temperature of the new sludge to the operating temperature (85 F). In the succeeding tanks only enough coil area was provided to compensate for the estimated loss of heat through radiation.

When the tanks were emptied and cleaned after 30 months of service, approximately half an inch of limy scale was removed from the heating coil. The cleaning more than quadrupled the conductivity of the pipes. Prior to the cleaning it was necessary to use all the coils in the first three tanks to raise the temperature to 85 F, but subsequent to the cleaning, hot water has been circulated only through the coils of the first tank in each battery. The tanks are handling more than twice the designed capacity, and additional heating surface would be desirable in the first tank.

Foaming is occasionally observed in the first and second tanks. The cause has not been discovered; acidity apparently is of no importance. Gas space of 6 ft in the first tank and 4 ft in the other tanks is provided to allow for foaming. In the first tank the foam has risen on occasion until it has just touched the top but has caused no operating difficulties. In the second tank the foam on one occasion passed into the gas lines.

The tanks were equipped with gas lifts for the purpose of stirring the sludge, but a comparison of the performance of one battery operated with the gas lifts as against the other battery operated without them, failed to indicate any difference. With the amount of mixing effected by the tank arrangement it is doubtful whether any additional stirring is warranted.

SLUDGE DRYING

The drying beds comprised 2.34 acres of underdrained sand beds, 6.0 acres of diked field, and 2.9 acres of shallow lagoons. The diked fields are constructed by grading open fields so that the sludge depth is about 2 ft. The soil is a tight adobe which gives little chance for seepage or underdrain. Sludge dried at the rate of 663 tons per acre per year on the sand beds and at the rate of 342 tons per acre per year on the field.

About 25 per cent of the sludge was wasted directly from the digestion tanks to the drying beds. For convenience in operation, the other 75 per cent was pumped to the pit before going to the beds or field. No difference in drying characteristics has been noted in the two sludges. Both dry without odor nuisance or the breeding of house flies.

TABLE I. COST OF DIGESTION, SLUDGE DRYING, AND FILTRATION OF SUPERNATANT LIQUOR

ITEM	DIGESTION	DRYING ON SAND BEDS	DRYING ON FIELDS OR LAGOONS	FILTRATION OF SUPERNATANT LIQUOR
Plant cost*	$132,000.00	$18,500.00	$3,000.00	$3,300.00
Operation cost, 1934:†				
Power, labor, and maintenance	3,075.00	2,460.00	500.00	440.00
Supervision	380.00	330.00	45.00	55.00
Interest and depreciation at 8%	10,580.00	1,480.00	250.00	260.00
Total	$ 14,035.00	$ 4,270.00	$ 795.00	$ 755.00
Costs per ton:				
Raw sludge	8,470 tons at $1.66	2,730 tons at $1.57	5,740 tons at $0.14	From 6,770 tons at $0.11
Digested sludge	4,800 tons at $2.92	1,550 tons at $2.75	3,250 tons at $0.25	From 3,840 tons at $0.20

* Does not include cost of land.
† Does not include cost of removing sludge from beds.

Measurements indicated a good deal of variation in the drainability of sludge from time to time. The most that can be said, from the 20 beds measured, is that when

the sludge is pumped to the beds with a solids content of 4½ per cent, it will in general give up about half of its moisture by drainage, and this in the first 48 hours. The remainder of the moisture is lost by evaporation.

PLANT AND OPERATING COSTS

Table I shows the costs for digestion and for drying on underdrained beds and open fields or lagoons. As most of the digested sludge is transferred to the pit prior to drying, the cost of the pit is included with the tank costs. It has but little influence on unit costs for digestion. The cost of land on which tanks, pit, and drying areas are laid out is not included, and no allowance has been made for the $6,000 annual saving that results from using the sludge gas instead of purchasing power for pumping.

Sludge is delivered wet, on the beds, to a fertilizer contractor who assumes the cost of its removal. The contractor pays the District $2.00 per ton of dry solids delivered on the sand beds and is given that which is delivered to field beds and lagoons.

DIGESTED SLUDGE HAS HIGH NITROGEN CONTENT

Multi-stage digestion as applied in this installation affords an excellent opportunity to study under plant-scale operation the chemical changes occurring during digestion. Space does not permit describing these studies in detail, but one important point deserves especial mention. In the sludge as it originally separates from the sewage, 98.6 per cent of the nitrogen is held in the solids, while 1.4 per cent is in the form of ammonium compounds or organic nitrogen in solution. When the sludge leaves the tanks, 56.8 per cent of the original nitrogen is still held in the solids, while 43.2 per cent is in solution. At the end of 23 days of additional digestion, the amount of the original nitrogen still held in the solids is reduced to 41.3 per cent.

When sludge from the tanks is dried, as is usual, to about 50 per cent moisture, 60 per cent of the nitrogen originally present will still be available for fertilizer value. If the sludge is digested for an additional 23 days and then dried to 50 per cent moisture, 46 per cent of the original nitrogen will still be available. These considerations point to the desirability of a short digestion period when the sludge is to be used for fertilizer. It must be noted, however, that a substantial amount of digestion occurs in the sludge from the tanks during drying; this was not taken into account in the calculation of the preceding values.

Aeration Tanks for Activated Sludge Plants

By S. W. FREESE
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IN the design of aeration tanks, the first step is to determine the required capacity. This depends upon three factors: (1) the quantity of sewage, (2) the percentage of return activated sludge, and (3) the aeration period.

The average daily sewage flow is a practical basis of design for works treating the average sewage collected in separate sewer systems. The ratio of maximum hourly flows to daily averages may vary considerably without disturbing the activated sludge process.

The length of the aeration period depends primarily upon the quality of the sewage and the degree of treatment required. Other factors that must be taken into account are the percentage of activated sludge mixed with the sewage, the character and biological activity of the sludge, the kind and intensity of aeration, the time and type of clarification, and the temperature.

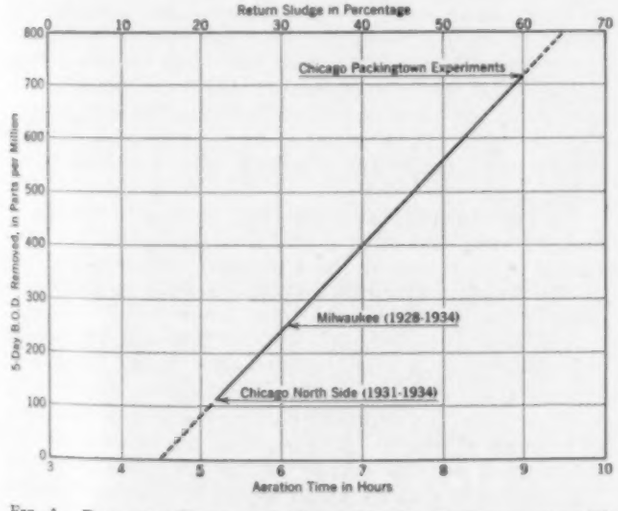

FIG. 1. RELATION BETWEEN 5-DAY B.O.D. REMOVAL AND (1) AERATION PERIOD OR (2) PERCENTAGE OF RETURN SLUDGE
The Two Curves as Plotted Coincide

During the first stage of the aeration period the impurities in the sewage are rapidly coagulated and adsorbed by the activated sludge, and the rate of coagulation-adsorption is proportional to the percentage of biologically active sludge in the mixed liquor. In the second stage, purification proceeds at the much slower and fairly uniform rate of oxygenation of the mixed liquor. During this second stage the presence of a large proportion of sludge probably retards the oxygenation of the sewage proper.

TIME AND RETURN SLUDGE REQUIRED FOR COMPLETE TREATMENT

For "complete treatment," the minimum aeration period varies with the strength of the sewage. To show this relationship I have plotted on Fig. 1 the aeration period against the 5-day B.O.D. removed for sewages of widely differing strengths—weak North Side Chicago sewage, the comparatively strong Milwaukee sewage, and the very strong Chicago Packingtown sewage. In each case a high degree of purification was accomplished. The sludge is not re-aerated at Chicago and Milwaukee, and the data used from the Chicago Packingtown experiments cover only those in which the sludge was not re-aerated.

Without re-aeration of the sludge it appears that the theoretical optimum percentage of return sludge is that percentage which will permit the required purification in a minimum of time and at the same time maintain an equilibrium of biological activity in the sludge. In general a minimum percentage of return sludge will mean a minimum time for "complete" purification of the sewage; on the other hand, if this percentage drops too

low, the sewage will not remain biologically active. The optimum percentage for the three plants already mentioned, plotted against the 5-day B.O.D. removed, is also shown in Fig. 1. The data are such that this curve coincides with that showing the relation between aeration period and 5-day B.O.D. removed.

Re-aeration or re-activation of the sludge is required when the aeration period of the mixed liquor is insufficient to maintain the biological activity or the oxygen requirements of the sludge. Re-aeration is also required with either complete or partial treatment if the aeration period is kept at a minimum and the percentage of return sludge is too small. Even with complete treatment of the sewage, re-aeration of the sludge may be economical where very strong sewages or industrial wastes are being handled.

SAN ANTONIO EXPERIMENTAL AERATION TANK
This Tank Is 40 Ft 10 In. Wide. There Are 3 Rows of Diffuser Plates on Each Side, and a Low Baffle Wall on the Longitudinal Center Line

Unless it is possible to conduct large-scale experiments with the particular sewage being studied, the safe procedure is to design aeration tanks on the basis of the minimum volume required without re-aeration, in line with the curve of Fig. 1, but to provide sufficient flexibility in the number of aeration tanks or channels that varying periods of re-aeration may be tried. Return sludge connections that will permit use of several of the channels as re-aeration channels can usually be provided at a relatively small additional cost.

DEPTH OF CHANNELS

The use of a depth of about 15 ft for aeration tanks is almost universal in the large activated sludge plants in the United States, although the plants at Houston, Tex., have a depth over the diffuser plates of 9¾ ft. There are also a number of smaller plants using diffuser tubes at relatively shallow depths (5 ft and less) but with tanks up to 15 ft in depth.

Oxygenation is not appreciably greater in the deeper tanks. This is probably due to two reasons. First, the bubbles rising through the liquid are enveloped in a surface tension film that includes some colloidal matter and interferes with the passage of oxygen into the liquid—at least until the bubble breaks the surface of the liquid—and second, the oxygen requirement of the sewage is only a small percentage, not over 10, of the oxygen in the air required for mixing and for maintaining aerobic conditions. Within practicable limits, therefore, it appears that the economic depth of tank can be determined by balancing the greater cost of compressing air for the deeper tank against the lower fixed charges for a tank of that shape.

EXPERIMENTS WITH WIDE CHANNELS

Until recently the ratio of width to depth of aeration tanks or channels has been maintained at less than 1.5, the British plants maintaining a ratio of approximately 1.0 and less. This was true of both the ridge-and-furrow and the circulating or spiral-flow types of tanks. Inasmuch as the later type has largely superseded the former, because of its lesser air requirements, this discussion is confined to a consideration of spiral-flow tanks.

The most careful observations available to the writer on the maximum width of tank consistent with good mixing and aeration are those made by the Sanitary District of Chicago at the North Side plant. The batteries were divided into 12 tanks, all but one of which were divided by longitudinal baffles into two channels, 420 ft long and 16 ft 1¾ in. in average width. These channels were equipped with two rows of diffuser plates, running longitudinally. In one tank, however, the dividing wall was omitted, giving a separate tank 33 ft 3½ in. in average width. Tests showed that the effluent from the 33-ft tank was as good as that from the 16-ft tanks, and no more air was required per gallon of sewage treated.

At the San Antonio activated-sludge treatment plant, the dividing wall was left out between two aeration channels in order to observe the aeration in the wider channel. This channel has a ratio of width (40 ft 10 in.) to water depth over diffusion plates (14 ft 7¾ in.) of 2.8. It is 150 ft long. There are three rows of diffuser plates along each side, and an inverted V-shaped baffle, 3 ft high, down the center. In 1934 the use of air per foot of channel length averaged 8.5 cu ft per min. The spiral flows creep from one side to the other of the center line of the tank; this creeping varies constantly and it is not known whether it is helpful in the mixing-aeration process or whether it tends to create dead spots. The effluent from the wide unit showed a smaller 5-day B.O.D. than that from the narrower ones; however, its flow had been throttled down so that there was a considerably longer detention time in it than in the tank of 20-ft width used for comparison. Further tests will be required to determine whether the results are actually the equal of those obtained in the single units.

An experimental aeration tank similar to the one at San Antonio, but with a width of 68 ft, has just been placed in operation at the Chicago Calumet plant. As at San Antonio, the diffuser plates are placed along both sides of the channel.

The San Antonio and Calumet experiments indicate the possibility of eliminating baffle walls, or at least cutting them down to small ridges midway between the rows of plates, by properly placing the longitudinal rows of systems of plates. If spiral flow can be satisfactorily maintained by the energy of the air alone, the only limiting factors as to width would be a ratio of length to width sufficient to avoid short-circuiting through the tank and a sufficient number of tanks to provide flexibility of operation.

Until such experimental works indicate otherwise, the proper limit of the ratio of width to depth would seem to be approximately 2 to 1 for channels with diffusion plates on one side only. The ratio should depend to some extent on the amount of air necessary in any particular case.

HOW MUCH AIR IS REQUIRED?

The introduction of air serves two purposes. First, it mixes the sewage with the activated sludge, and second, it maintains aerobic conditions in the mixed liquor. The meeting of the second condition will more than satisfy the first, except possibly in the case of partial treatment plants requiring re-aeration of the sludge.

The amount of air required to maintain aerobic conditions in the mixed liquor or sludge for the required aeration period is approximately ten times the air required to meet the B.O.D. of the sewage in an efficiently operated air-diffusion plant. Even then a large part of the oxygen demand is no doubt met by oxygen from the atmosphere rather than from the diffused air introduced into the sewage, the atmospheric oxygenation taking place as the air bubbles break the surface of the liquid. The quantity of air required in an efficiently operated plant is directly proportional, within fairly narrow limits, to the B.O.D. removed.

The amount of free air required per part of B.O.D. removed overall by a "complete treatment" air-diffusion plant seems to be largely independent of the aeration period, the percentage of return sludge, the re-aeration of sludge, the preliminary treatment by screens or settling, and the depth of the aeration tank. The arrangement of the diffuser plates, however, has a very decided effect on the amount of air required to maintain aerobic conditions. To effect an equal degree of purification, spiral-flow tanks with diffuser plates placed longitudinally along one side require approximately 25 per cent less air than do the ridge-and-furrow tanks, in which the rows of diffuser plates are placed crosswise of the channels.

The absence of preliminary treatment does not adversely affect the amount of air required per part of 5-day B.O.D. removed by the plant as a whole. This is no doubt due to the fact that any solids removed by preliminary treatment would settle out in any case in the final clarifiers, and to the further fact that those solids are of such a nature that they will absorb only a negligible amount of oxygen as they pass through the aeration tanks.

In the design of aeration tanks for "complete-treatment" air-diffusion plants without paddle wheels or other mechanical aids to aeration, treating sewage without any unusual trade wastes, it seems safe to provide 0.005 cu ft of free air per gal of sewage (average flow) per ppm of 5-day B.O.D. to be removed from the raw sewage by the overall plant. Sufficient flexibility should be provided in the number and capacity of air compressors to permit reducing this quantity to 0.004 cu ft or even less.

There is promise of further improvement in aeration methods by utilizing a combination of air-diffusion agitation with mechanical agitation such as that employed by Dr. Imhoff at the Essen-Rellinghausen (Germany) plant, in which submerged paddles on a horizontal shaft running the length of the aeration channel revolve in a direction opposite to the motion imparted by the air-diffuser plates along the sides (see Fig. 2). Dr. Imhoff reports that with diffused air alone, from 0.8 to 1.12 cu ft of air per gal and 24 hp per million gal per day were needed, but that with paddles in operation, 0.16 cu ft of air per gal and 8.4 hp per million gal per day were found to suffice. Messrs. Mohlman and Wheeler of the Sanitary District of Chicago reported similar results obtained on large-scale experiments.

AREA AND PERMEABILITY OF DIFFUSER PLATES

Tank dimensions, aeration period, percentage of return sludge, and quantity of air per gallon of sewage having been determined, the area of diffuser plates required is within certain limits a matter of economic balance between the cost of their installation and the cost of compressing air to take care of the pressure loss through them. The practicable range of air quantity per square foot of

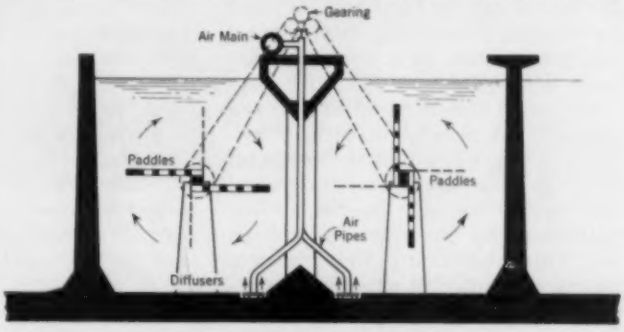

FIG. 2. CROSS SECTION OF AERATION TANK EQUIPPED WITH AIR-DIFFUSERS AND PADDLE WHEELS

plate seems to lie between 1 and 4 cu ft per min; operating difficulties are encountered outside of these limits. As indicated by the experience of the Chicago North Side and San Antonio plants, 4 to 6 cu ft of air per min per ft of channel will induce a circulatory flow sufficient to prevent deposition of solids from grit-free mixed liquor in channels 15 ft deep and 33 to 40 ft wide.

The size of the air bubbles is important. William T. Lockett reached the conclusion as a result of some experiments with Manchester sewage that diffused air is approximately three times as effective as air applied in the form of large bubbles such as obtain with plain tube aeration. It was formerly thought that the size of bubble from diffuser plates varied inversely as the permeability of the diffuser plate, but it has been found that permeabilities of between 30 and 40, and even up to 50, are satisfactory, and that there is very little difference in the size of bubbles diffused from plates with a permeability of 15 and those from plates with a permeability of 60. Plates of higher permeability not only have lower frictional resistances (4 in. of water, more or less) but also do not clog so readily.

Plate containers have usually been built of precast concrete, sometimes with non-rusting metal edges next to the plates and with metal supports between plates. A cast-aluminum container has recently been developed. Cement grout is the generally accepted jointing material; however, the plates cannot be readily removed where a cement grout is used. The use of rubber gaskets and wedges with clamps for holding the plates in place obviates this difficulty. Such gaskets should be corrugated to obtain a good air seal.

Many of the early activated sludge plants (Houston, et al) used air lifts for returning sludge; however, most of the large plants built in the United States since the Houston plant have used centrifugal pumps. The Chicago Sanitary District has developed an air lift sufficiently efficient to meet its particular needs at the new Southwest Sewage Treatment Works, and has incorporated sludge-return air lifts in the plans for the Southwest Treatment Plant. The choice is largely a matter of cost, although the air lifts no doubt accomplish some aeration.

The Disposal of Garbage with Sewage

Central Grinding Plants, Discharging into the Sewerage Systems, Are in Operation in Several Cities

By C. E. KEEFER

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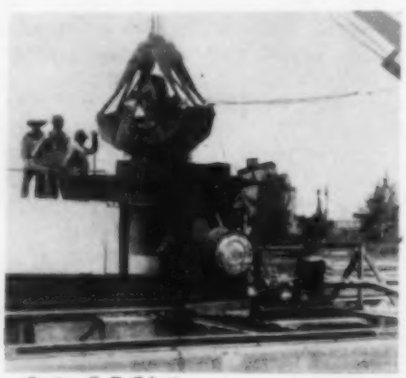
WITH few exceptions, even the larger centers of population still dispose of garbage by methods that are at best antiquated, if not actually nuisance-creating and unsanitary. Many a modern city with a scientifically designed plant for treating its sewage still carts its garbage across town to the hog lot. Recently, however, considerable attention has been given to devising more satisfactory means of garbage disposal. Several municipalities now incinerate their garbage, and a few have adopted, or at least are experimenting with, the method described here, in which the garbage is ground, turned into the sewers, and digested with sludge at the sewage treatment plant. Although this scheme is relatively costly and presents various operating difficulties, nevertheless it has proved its worth and deserves serious consideration. The present article is abstracted from a paper by Mr. Keefer presented before the Sanitary Engineering Division on January 16, 1936, at the Annual Meeting of the Society.

IN 1923 C. R. Fox and W. S. Davis originated the idea of grinding the garbage of Lebanon, Pa., and discharging it into the city sewers, which terminate at a sewage treatment works.

Although this method of garbage disposal has several attractive features, it was not adopted elsewhere, so far as is known, for several years. One reason for this inertia among engineers and city officials perhaps was the conviction that sewage plants were difficult enough to operate without the addition of garbage. But when the digestion of sewage sludge was put on a firm scientific basis by the research work of Willem Rudolfs and Gordon M. Fair, Members Am. Soc. C.E., and others in the years following 1924, it seemed logical to extend their investigations to a study of the digestion of mixtures of garbage and sludge.

In August 1932, therefore, laboratory experiments along this line were begun at the Baltimore (Md.) sewage works. It was found that when garbage, or a mixture of garbage and raw sludge, was added to a sufficient quantity of digested material, incubated at 28 C and kept at a pH value of from 6.8 to 7.2, digestion was complete within 30 to 40 days. The amount of gas produced and its methane content were approximately the same as when sewage solids alone were digested. Furthermore, the digested material had all the characteristics of ripe sludge and could be quickly dewatered on drying beds. The experiments also showed that when daily additions of a mixture of equal parts of garbage and raw sludge are added to digested material in amounts as great as 5 per cent of the initial volatile solids in the ripe sludge, the end-product remains non-offensive and easily dewaterable. Other studies have been made by Fair at Harvard University and by F. H. Whitely at the University of Illinois.

The disposal of garbage via municipal sewerage systems is now attracting considerable attention. A grinding station was built in Baltimore in 1933 to dispose of the peak production of garbage. During a period of 24 days in that year a total of 1,693 tons of garbage was turned into the outfall sewer, which discharges at the municipal sewage plant. During the summer and fall of 1935 a large amount of garbage was ground at Indianapolis, Ind., and treated with the sewage by the activated sludge process. In the same year, at Durham, N.C., shredded garbage was discharged into the city sewers and treated at the sewage plant. At St. Louis, Mo., garbage is disposed of into sewers that discharge into the Mississippi River.



Courtesy C. K. Calvert

THIS GARBAGE GRINDER, AT INDIANAPOLIS, IND., IS MOUNTED DIRECTLY OVER THE GRIT CHAMBER OF THE SEWAGE TREATMENT WORKS

Three general methods of combined disposal have been suggested. The first consists of hauling the material to the sewage works, grinding it, and discharging it into Imhoff or sludge digestion tanks. By following this procedure the garbage would not come in contact with and increase the strength of the sewage. One objection would be that the material might have to be hauled for long distances to the sewage works.

The second method consists of erecting central grinding stations in various parts of the city, to which the garbage would be hauled and from which it would be discharged into the sewers. The third includes the use of household garbage grinders, but as these units cost approximately $160 installed, they could not be expected to come into universal or even general use. This method would therefore have to be used in combination with one of the other two.

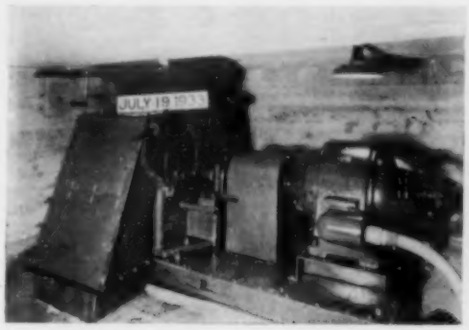
EFFECT OF THE ADDITIONAL LOAD ON SEWERS AND TREATMENT PLANT

The quantity of garbage produced daily in an average American city amounts to only some 0.06 of 1 per cent of the quantity of sewage produced in the same period. Therefore there should be no need of increasing the size of sewage conduits because of the addition of garbage. This statement also applies to grit chambers, settling tanks, and other treatment units whose size is in general independent of the amount of solids in the sewage.

The increased concentration of these solids, rather than the relative quantities of garbage and sewage, is the chief factor that must be taken into account. The dry-solids content in the garbage produced by 1,000 persons averages 125 lb daily, while the total solids in the sewage from the same population amounts to 667 lb daily. The total solids at a sewage works would accordingly be increased about 19 per cent by the addition of garbage. Some of the ground material would be of such a size that it would be intercepted at the sewage works on fine

or coarse screens, but the major part would be deposited in the preliminary settling tanks. Moreover, some of the solids would be in such a finely suspended form that they would pass off with and increase the strength of the effluent. The load on the secondary treatment units, or on the diluting water, therefore would be increased.

It is of interest to compare the amount of total solids in the garbage with the quantity of sludge obtained from ordinary sewage in preliminary settling tanks. If all the garbage were removed in these tanks, the volume of sludge would be increased 118 per cent under average conditions. Also there would be a corresponding increase in volatile solids and ether-soluble matter of 153 and 63 per cent, respectively. It should be understood that all these quantities represent average conditions, and that a variation of 100 per cent or more may be expected at different times of the year and in different cities. The production of garbage in summer may be 50 per cent or more above the average. Fortunately this increase usually occurs when the biological processes at a sewage plant are most efficient. On the other hand, odors are more of a problem in summer, and in addition the diluting waters that receive the effluent of the treatment plant cannot absorb so much of an organic load at that season as during the colder parts of the year.



A CENTRAL GRINDING STATION AT BALTIMORE, MD.

Garbage, Dumped from Trucks on the Floor Above, Is Shoveled Into the Hopper and Passes Through the Grinder Into the Sewerage System

Insufficient data are available to determine what increase may be expected in the 5-day B.O.D. of raw sewage as a result of the addition of garbage. One incomplete group of tests, made under the direction of the writer, showed an increase of 10.7 per cent. An increase of 20 per cent has been reported by M. M. Cohn, Assoc. M. Am. Soc. C.E., and H. E. Babbitt, M. Am. Soc. C.E., has estimated it at 25 per cent. Additional tests should be made to obtain further information on this point.

Would the ground material from individual houses or from central grinding stations obstruct the sewers? As regards the grinding of garbage in the home, insufficient experience is available to reach definite conclusions, but the solids that pass through the household grinder are certainly smaller than much of the suspended material in sewage, and it is believed therefore that they would have even less tendency to clog the sewers than normal sewage solids. It is possible, of course, that where sewers are partially obstructed by tree roots or have very flat grades, the addition of ground garbage either from the home or from central stations may increase the required frequency of cleaning.

Where garbage is turned into sewers from central grinding stations, the ratio of garbage to sewage is likely to be much greater than from individual houses provided with garbage grinders. Considerable care, therefore, must be used in selecting the sites of these stations. The sewers should be large and have sufficient grades with good velocities. If grinding stations are located with these points in mind, there should be little danger that obstructions will form.

ADDITION OF GARBAGE MAY COMPLICATE THE OPERATION OF SEWAGE TREATMENT WORKS

There is no doubt but that the disposal of ground garbage into the sewers will considerably increase the cost and add to the problem of sewage treatment. Some treatment units will take more of a load than others. Screens especially will be affected. For example, experience at Baltimore indicated that when corn husks were ground in summer the quantity of screenings removed from racks with $^{7}/_{8}$-in. openings increased by 50 to 55 per cent. A good deal of this material consisted of stringy fibers from 6 to 8 in. long. Where garbage is discharged into sewers at central grinding stations, either the pulverizers should be designed to grind all the material thoroughly, or adequate screening facilities should be provided at the sewage works for treating the increased load.

The effect on the operation of grit chambers should not be overlooked. Calvert, at Indianapolis, found it desirable to remove heavy bones, tin cans, and glass from the garbage in order to reduce the quantity of material to be removed from the grit chamber. He also observed that the volatile solids in the grit increased from less than 30 per cent during normal operation when garbage was not ground, to from 50 to 65 per cent during grinding periods. The material removed from the grit chamber was naturally quite offensive. Calvert indicates that some modification in the operation of the grit chamber would be necessary. Grit containing such large quantities of volatile matter is difficult to handle and will produce a nuisance unless promptly disposed of.

The formation of additional scum and grease in preliminary treatment units can be expected. During the summer of 1933, when ground garbage was turned into the outfall sewer at Baltimore, this increase was considerable. The scum contained a large amount of ground garbage. At Indianapolis, the skimmings and the grease removed from the grit chamber increased from 0.74 to 2.97 cu ft per million gal of sewage. The problem of disposing of this material should not be underestimated.

Generally speaking, the preliminary sedimentation of sewage containing ground garbage should not be a difficult problem. Mixtures of garbage and sewage solids appear to settle as well as sewage solids alone. It is certainly true that the grinding process places some of the garbage in such fine suspension that it will not settle. Such being the case, the effluents from sedimentation tanks that treat both sewage and garbage will be stronger than those from tanks treating sewage alone. According to an estimate by Cohn, the effluents from preliminary settling tanks can be expected to have a B. O. D. from 15 to 20 per cent higher when ground garbage is added.

The effect on secondary treatment units is of special importance. During the time that garbage was added to the Baltimore sewage, the 30 acres of trickling filters worked as efficiently as at other periods of the year. However, only about 20 per cent of the total garbage production was discharged into the outfall sewer. It is possible that operation of the sewage works might have been seriously impaired if all the garbage had been so treated.

Calvert concludes from his observations at Indianapolis that "the ground garbage caused no difficulty of any sort in the activated sludge plant, it being impossible to tell by observation when grinding was in progress." He also stated that the addition of garbage may re-

quire an increase in plant capacity and power of less than 3 per cent.

DIGESTION OF MIXTURES OF GARBAGE AND SLUDGE

Most of the studies dealing with the combined treatment of garbage and sewage have been confined to the digestion of mixtures of garbage and sludge in the laboratory. As has been previously stated, it was shown at Baltimore that there were no difficulties in digesting equal volumes of raw sludge and garbage, provided sufficient seeding material was used and the proper temperature maintained. Cohn was also successful in digesting mixtures of garbage and sewage sludge in the laboratory. D. E. Bloodgood, at Indianapolis, obtained good results when he digested mixtures of primary sludge, activated sludge, and garbage in such proportions that 33 per cent of the volatile solids present was in the garbage. He reported that the garbage speeded up digestion and that the quantity of gas produced per unit of volatile garbage solids was at least twice that from the primary and activated sludges.

Courtesy General Electric Company

NOT EVEN A BONE FOR THE DOG

This Household Grinder Makes Easy Work of Garbage Disposal

Sludge and garbage digestion in Imhoff tanks and separate sludge tanks has been observed at a few places. At the sewage testing plant of the University of Illinois, daily charges of garbage were added to the Imhoff tank, which was capable of serving approximately 250 persons. The ground garbage was equivalent to a load produced by 100 persons. Babbitt found that it was impossible to obtain a satisfactory effluent and that good digestion could not be obtained. Unfortunately he does not give the total population load and the temperature in the digestion chamber during the experiment.

The quantities of garbage added to the sewage in Baltimore in 1933 were too small to show what the effect would be on sludge digestion. At Indianapolis, where the primary and activated sludges are digested in large lagoons, the garbage had no effect on the odors from the lagoons, and digestion appeared to be as good as when sludge alone was present, if not better. However, analyses were not given to indicate the physical and chemical characteristics of the digesting material.

It is too soon to predict how satisfactorily and quickly garbage can be digested with sewage sludge in Imhoff and separate sludge tanks. It is of course apparent that sufficient capacity must be available to provide for the additional load of organic material. It is possible that erratic and poor results would often be obtained in Imhoff tanks, where the sludge lies dormant for months in winter and where foaming frequently occurs for no apparent reason.

ADVANTAGES AND DISADVANTAGES OF COMBINED GARBAGE AND SEWAGE DISPOSAL

Even if satisfactory solutions are found for such operating problems as may arise in connection with the treatment plants and the sewers themselves, central grinding stations are not devoid of certain objectionable features. Garbage grinders are noisy, and can be heard for as much as 400 or 500 ft away. Furthermore, they are not free from odors even under the best conditions. It is advisable not to locate them near dwellings.

The cost of grinding garbage and of subsequent treatment at the sewage works should not be overlooked. With the cost of a household grinder at $160 installed, only a minority of the population of a city could afford one. It remains, therefore, to investigate the cost when using central grinding stations. Calvert has estimated the total cost, including fixed charges, of operating a garbage grinder station with a capacity of 24,000 tons per annum to be $0.372 per ton. The writer's estimate for operating a station of similar size under Baltimore conditions is $0.426 per ton. To this must be added the cost of handling the solids at the sewage works. In nearly every case the garbage would have to be digested and then dried on sand beds. H. F. Ferguson and W. H. Wisely have found the total cost of sludge digestion and sludge drying, including fixed charges, at six plants in Illinois to average $11.23 per ton of dry raw solids. If it is assumed that garbage can be handled as readily as sewage solids, the cost of treating garbage containing 25 per cent solids would average $2.81 per wet ton. Including grinding charges, the total cost per ton under average conditions would be about $3.20. This cost does not include the expense of handling and treating additional quantities of screenings, grit, scum, and grease. Moreover, it is possible that secondary treatment units such as trickling filters, intermittent sand filters, or aeration tanks used in the activated sludge process might have to be enlarged because of the increased strength of the effluent from preliminary settling tanks. If so, corresponding additional fixed and operating costs would have to be included.

The cost of garbage reduction or incineration varies widely. A report prepared by the Civic Development Department of the U. S. Chamber of Commerce indicated that the operating cost of garbage and refuse incineration in 154 cities averaged $1.26 per ton. Less information is available regarding the fixed costs of garbage incinerators, but it is believed that the total cost of incineration in general should not average more than $2.50 per ton. Garbage in Baltimore is disposed of by a private contractor, who at his own cost constructed and operates an incinerator plant. He receives $1.85 per ton of garbage disposed of. At the termination of the contract, which runs for 10 years, the incinerator plant will become the property of the city.

One of the advantages of grinding garbage and discharging it into sewers is that the cost of transportation should as a rule be less. Another advantage is that grinding stations occupy little room and are inexpensive to build. Calvert estimates the cost of a station with a capacity of approximately 80 tons a day to be $23,500, or about $294 a ton. A 160-ton plant was built in Baltimore for $8,585, or approximately $54 per ton. The reason for the low cost of the latter plant was that the superstructure was of sheet metal, and every effort was made to keep the cost at a minimum. A garbage incinerator costs two or three times more than Calvert's estimate.

It is difficult to predict whether there will be a general tendency in the future to adopt such methods as those described here. It is advisable that laboratory work be continued, and that its results be checked more extensively on a plant scale. However attractive the combined treatment of garbage and sewage may appear in certain instances, it should be adopted only after the most careful study.

Recent Developments in Pavement Design

Scientific Methods Are Replacing Rule-of-Thumb in the Design of Highway Pavements

By JULIUS ADLER
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THERE have been two simultaneous trends in the field of highway engineering during the past several years: (1) A widespread desire and concerted drive for the development of improved types of low-cost roads capable of sustaining moderate year-round traffic; (2) an attempt to improve upon or correct defects in the older well-established types of pavement.

The development of the main and secondary highway systems in many localities recently focused attention on the requirements of the "local use" roads, but whether the later unusual activity in low-cost road construction was the next logical step in the development of a national highway system, or whether it was largely the product of disjointed economic conditions, remains to be determined.

One valuable result of the increased construction of low-cost roads has been an intensified study of soils, made in order to arrive at a better understanding of their classification and behavior, and of means for their improvement, either for the purpose of forming a suitable subgrade for a higher type of pavement, or for the development of a low-cost wearing surface.

UNDERLYING most of the recent improvements in the design of all types of highway pavements has been the introduction of research methods and a closer study of the relationships between the various materials employed. The importance of soil stabilization is being recognized more and more, not only in the construction of low-cost wearing surfaces, but also in providing a suitable subgrade for higher-type roads. Increased activity is noted in the use of various types of cold bituminous mixtures. Brick pavements have enjoyed some return to favor, owing to the use of harder, tougher brick laid with a slightly roughened surface uppermost, and improved methods for removing the excess asphalt left from pouring the joints. Developments in the construction of concrete, hot-mixed bituminous, and granite-block pavements are also discussed in this article, abstracted from the paper delivered by Mr. Adler on January 16, 1936, before the Highway Division at the Annual Meeting of the Society.

IMPORTANCE OF SOIL STABILIZATION RECOGNIZED

Few natural soils found in the bed of a road, when exposed to extreme variations in moisture, are capable of escaping considerable displacement under traffic, even after the usual provisions for drainage have been made. Soil stabilization, therefore, consists in the treatment of the natural soil by any one of a number of methods designed to overcome this defect.

There can be no question but that the matter of providing a stable subgrade for pavements has failed to receive the consideration it warrants, and the indications that this defect is about to be corrected constitute a very important recent development. A comprehensive discussion of the importance of surveying and sampling soils preliminary to the formation of a highway subgrade, together with methods of procedure, is contained in a tentative standard method adopted by the American Society for Testing Materials in 1935 under the serial designation D-420. The first paragraph of this tentative standard states that the purpose of the subgrade survey is to furnish the engineer with significant information on the final location of the road both vertically and horizontally; the selection of suitable fill material; the design of the roadway section; the design and location of ditches, culverts, and drains; the need for subgrade treatment and the type of treatment required; and the selection of the type of road surface and its design.

The methods of survey and soil examination there proposed will appear distinctly burdensome to most highway organizations. Short cuts will undoubtedly be developed, and the suggested work procedure can probably be curtailed. In particular, there is need for a much wider diffusion of knowledge of soils and their behavior, and for more ability to interpret the results to be obtained from the examination of soil samples before this work can be successfully made a part of routine procedure. But attention is being directed definitely to the

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STABILIZING A SOIL ROAD WITH ASPHALT

Behind Each Scarifier Tooth of the Sub-Oiler Is a Pipe with Orifice for the Introduction of Asphaltic Oil

© *Portland Cement Association*

WIDENING CONCRETE HIGHWAY, U. S. ROUTE 1, NEW JERSEY

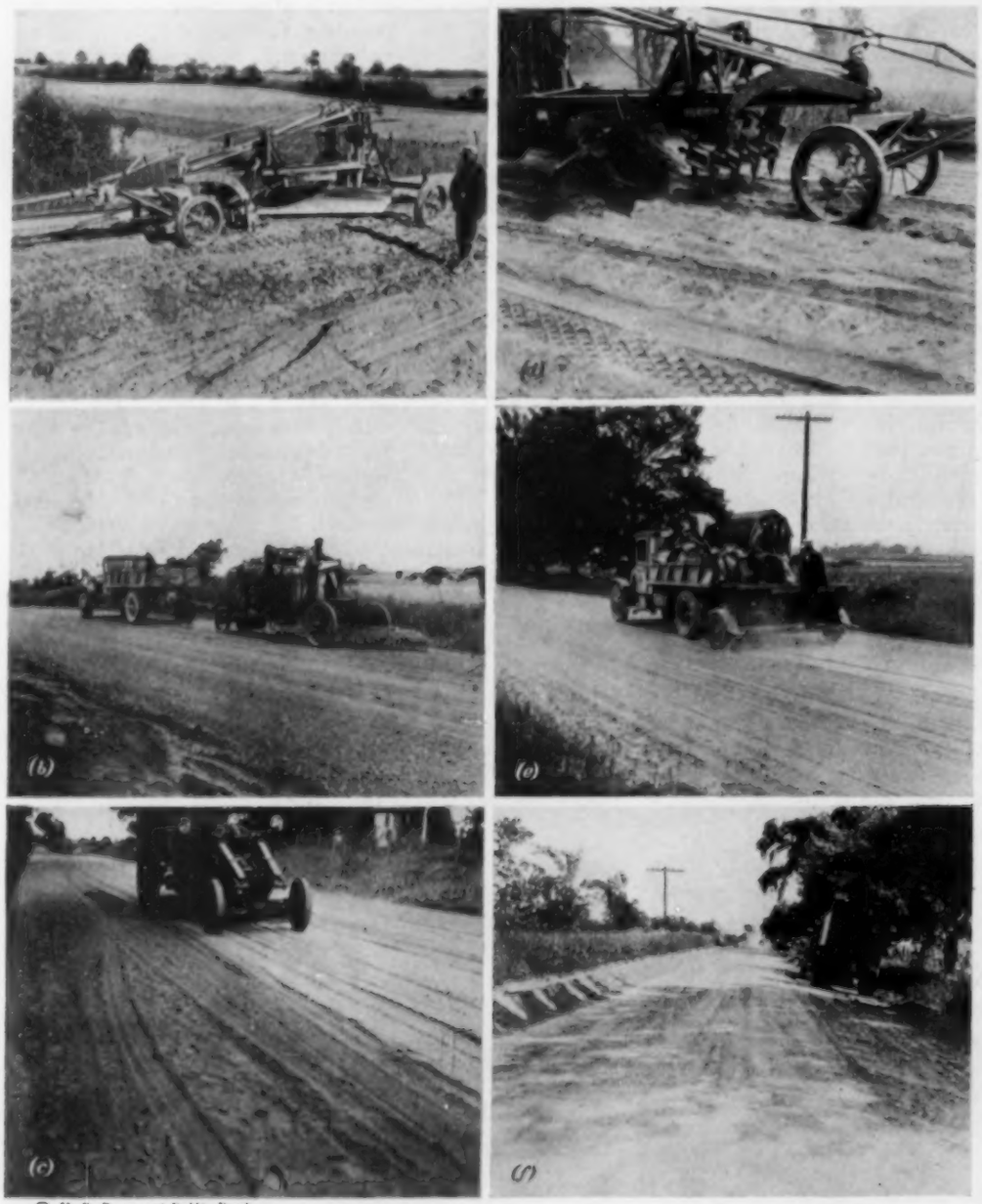
Low Sloping White Cement Concrete Curbs Are Placed on Both Sides of Center Dividing Strip, Using a Small Portable Vibrator

fact that knowledge of stable subgrades and methods for their production is necessary.

DEVELOPING MEANS FOR STABILIZING THE SOIL

Methods of soil stabilization for the production of low-cost wearing surfaces or improved subgrades are too numerous to discuss in detail. The starting point for many forms of this work lies in reproportioning the coarse, medium, and fine components of the soil or surfacing material so as to produce a dense mixture, capable of shedding excess water and yet capable of retaining sufficient moisture during dry weather to secure the binding effect of capillary moisture films. A deliquescent salt, such as calcium chloride, may be used to aid in retaining moisture in the road material during periods of dry weather. Stabilization may also begin with the use of a cementing material, such as asphalt oil or tar in the bituminous class, or portland cement in the nonbituminous. The object in any case is to exclude water as completely as possible and to replace it by another cementing agent. The specific materials referred to are simply mentioned as prominent examples of the numerous materials being employed regularly or experimentally for this purpose.

Many of the methods now being used for the production of low-cost road surfaces are distinctly not new. More than 25 years ago, it was common practice in the southeastern states and elsewhere to add sand to clay and clay to sand or loose gravel in order to increase stability. In California and other states the practice of applying asphalt oil to earth roads was widespread, and other processes among those named were employed on a smaller scale. Increased activity in the production of asphalt or tar-bound road surfaces, whether by "mixed-in-place," plant-mixed, or other method, represents renewed use of an older method of construction rather than a new method. Really important recent developments in this work are the introduction of research methods, and an attempt to arrive at a clear understanding of relationships and reactions between the materials—in other words, the substitution of scientific procedure for the old cut-and-try methods. A reasonable number of failures must be expected. Where enthusiasm is substituted for knowledge of good design, the percentage of failures will be substantially greater.



© *U. S. Bureau of Public Roads*

STABILIZING A MICHIGAN SOIL ROAD WITH CHEMICAL

(*a*) Scarifying the Old Surface
(*b*) Removing Large Stone with Rake
(*c*) Spreading Pulverized Clay Admixture
(*d*) Deep Blading to Mix Clay with Old Material
(*e*) Spreading Chemical Over Smoothed Surface
(*f*) Mixing by Blading in Windrows

PROGRESS IN PORTLAND CEMENT CONCRETE PAVING

Widespread attention has been given in recent years to the design and construction of concrete highways, so that there appear to be few strictly new developments to be reported at this time. Hence discussion will refer only to the progress being made on developments which have been under way for some time.

Reducing the design of concrete road slabs to a mathematical basis constitutes a fundamental improvement. Design on this basis, which involves character of subgrade support, strength of material, and stresses arising from anticipated loads and from temperature and moisture variations, cannot be said to be a matter of established procedure at this time. But studies both completed and in progress indicate that such developments may be anticipated. The comprehensive investigations of the U. S. Bureau of Public Roads (reported in *Public Roads*, October to December 1935) will undoubtedly have a marked influence on rational slab design.

It should be noted, however, that in such design there is no escape from the use of empirical constants, in particular the constant representing the character of subgrade support. Since any design formula must assume the existence of uniform support extending over apparently similar subgrade areas, attention is again directed to the importance of developing means either for an actual improvement in subgrade stability, or at least for subgrade treatment designed to ensure uniformity of support over a considerable area. Otherwise the basis for proper slab design will be lacking.

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CONSTRUCTING A COLD-LAID BITUMINOUS STREET IN KANSAS CITY
From Right to Left Appear Aggregate Dump Trucks, Traveling Asphalt Plant, Grader, and Tractor

Vibration of concrete in road slabs will not be discussed since it is a construction development, but if this process is found satisfactory and practical, it will naturally lead to more economy and adaptability in the design of mixtures. Since vibration makes possible the use of drier mixes, obviously a required strength may be obtained with a lower cement factor. At the same time the reproportioning necessary to obtain the best results from vibration requires a higher proportion of coarse aggregate, which also contributes to reduction in mixing water.

USE OF PLANT-MIXED BITUMINOUS PAVEMENTS INCREASES

Of particular interest has been the accelerated development and use of "cold" bituminous mixtures. This is no doubt due to increased activity in bituminous paving construction at points distant from the large centers of population with their permanent-type asphalt plants designed for "hot-mix" work, and also to a desire to obtain mixtures at lower costs. Certainly the field of operations has been considerably expanded by the introduction of these mixtures.

The design of cold-mix bituminous pavements involves proper selection of materials (principally the bitumen itself) coupled with methods of manipulation such that the resulting mixtures will not solidify excessively either while in transit or during a reasonable period of storage, but will retain sufficient workability to permit spreading on the road surface without further treatment. When subjected to compression by rollers and further compaction by traffic, the mixtures should acquire sufficient density and stability to produce a durable pavement.

A large number of such paving mixtures are being offered for use. Many of them are proprietary in character, and the task of classifying them would be a difficult one—certainly beyond the scope of this paper. Three prominent basic types may be mentioned, however, by way of illustration: (1) Those employing a cut-back bitumen, either asphalt or tar, as the cementing material to maintain workability until the more volatile elements have evaporated; (2) those employing an asphalt emulsion, in which the asphalt does not take a "set" until exposed to the air after the mixture is spread in a relatively thin layer; (3) those in which a hard, powdered asphalt and a flux are employed in the mixing process, the flux providing workability until the mixture is spread on the road, after which combination of the hard and soft bitumens should produce stability. The proponents of each of these classes of mixes claim that the absence of high temperatures during the mixing process preserves the cementing qualities of the bitumen, free from oxidation, hardening, or any other form of deterioration.

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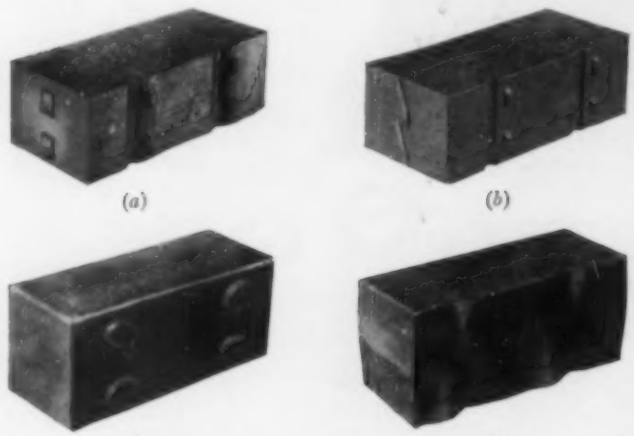
ROAD-MIX BITUMINOUS PAVING EQUIPMENT
The Trend in Road-Mix Operations Is to Use Equipment Requiring Only One Passage for Thorough Mixing

In the field of hot-mix pavements, such as sheet asphalt and asphaltic concrete, developments in design during recent years seem to be definitely lacking. Nevertheless, indications are plentiful that this field of work is on the verge of far-reaching changes in design methods. Changes in the composition of asphalt mixtures made some years ago for the purpose of increasing stability (resistance to displacement under traffic) in many cases have resulted in mixtures susceptible to cracking during periods of extreme cold weather in more northerly locations. In some cases reducing the amount of bitumen, lowering its penetration, and increasing the filler content of the mixture went well beyond the requirements for improved stability and were certainly detrimental to the life of the pavement in other respects. Hence the time is now ripe for a comprehensive study of asphalt cements and asphalt mixtures in order to forecast their behavior in pavements under traffic and under extremes of temperature.

Since standard methods of test are entirely inadequate for this purpose, and technical literature indicates unusual activity by investigators of the physical properties and behavior of completed asphalt mixtures, it is reasonable to suppose that a revamping of asphalt paving

specifications will soon be under way in a form correlating more nearly the character and service behavior of the materials.

Reports of the work of several investigators published during the past year showed that tests were being made on asphalt mixtures at low temperatures for toughness or resistance to impact, for tensile and flexural strength, and for shearing strength. These tests,



© *National Paving Brick Association*

FOUR TYPES OF PAVING BRICK
(*a*) and (*b*) Two kinds of Vertical-Fiber Lug, (*c*) Wire-Cut Lug, and (*d*) Repressed Lug

which involved the work of several different investigators, do not appear altogether compatible for this particular study, but the least possible number of tests which will furnish the desired information should evidently be sought.

DEVELOPMENTS IN VITRIFIED BRICK PAVING

Certain well-defined trends in the design and construction of vitrified brick pavements have been in evidence for a number of years. Repressed brick, with its tendency toward a non-homogeneous structure, had been replaced more and more by wire-cut brick, on which lugs, if used at all, were formed during cutting. Plain wire-cut lugless brick, however, gradually fell into disfavor owing to the difficulty of providing a uniform joint of sufficient width to permit the ready entrance of the joint filler. At the same time, asphalt filler began to supplant grout filler, which had been responsible for destructive stresses in the thin brick slab.

At this stage in the development of brick pavement, a mat of asphalt of variable thickness was found on the newly completed surface unless a tedious hand-pouring process of joint filling was employed, which reduced but did not eliminate the excess asphalt. The asphalt surface was objectionably slippery in wet weather, but even after its removal by traffic, the exposed brick surface, if either of the wire-cut lug or the repressed type, was too smooth to provide the best traction.

This situation is now improved as a result of the recent development of a wire-cut lug brick of the vertical-fiber type, which is laid with the slightly roughened surface (formed by the passage of the cutting wire) uppermost. Lugs on one side and end, sometimes supplemented by vertical grooves, ensure proper joints. In addition, a process has been developed for removing the surplus asphalt from the surface of the newly laid brick pavement. This involves the use of a separating agent which, temporarily at least, prevents the adhesion of the asphalt and so facilitates its removal.

During the past two years considerable attention has been directed to the de-airing process in brick manufacture, in which the clay is subjected to a vacuum before being formed into a bar. The primary result is an increase in density of the clay bar and of the finished brick, but the average values of all other physical characteristics are appreciably changed. The abrasion loss, as determined by the standard rattler test, is materially reduced, test results as low as 15 per cent being not unusual. The published results of a limited number of tests for toughness, abrasion, and crushing strength, ordinarily made on rock, give figures which would approximate those from a good grade of stone. The specific gravity, however, is approximately 8 to 10 per cent less than for the average granite or sandstone. This process, as applied to brick-making, is believed to be still in an experimental stage, and its ultimate value is therefore difficult to forecast.

No outstanding developments in granite-block paving design have occurred lately. However, the recent employment of a separating agent to remove excess asphalt mastic from the surface of newly laid granite blocks should prove important. With granite block as with brick, the existence of surface mats of excess bitumen has been objectionable in hot weather on account of stickiness, while in wet weather the slippery surface is the cause of numerous accidents.

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Applying Calcium Chloride Solution Before Pouring Asphalt

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Spading Up the Excess Asphalt After Joints Are Completely Filled

METHOD FOR REMOVING EXCESS ASPHALT FROM BRICK PAVING, PHILADELPHIA

Highway Connections for Triborough Bridge

Elaborate Connections Are Amply Justified for New York City's Latest Bridge Project

By J. C. Evans

Engineer of Approaches, Triborough Bridge Authority, New York, N.Y.

Fourteen miles of wide highways, for the most part paved with asphalt on a concrete base, will serve the 3½ miles of crossing structures which constitute New York City's Triborough Bridge, connecting the boroughs of Manhattan, the Bronx, and Queens. These connections, not including the roadways that join the crossings with the natural terrain, better known as approaches, are being constructed at a cost estimated at about 40 per cent of the cost of the entire project. Modern trends in bridge planning sustain the propriety of this expenditure, as such connections have demonstrated their value in attracting traffic and in speeding it to and from fixed crossings. Grade separations are used at most of the intersections of the bridge connections with other highways. The article is abstracted from Mr. Evans' address on January 16, 1936, before the Highway Division, at the Annual Meeting of the Society in New York.

CONSIDERABLE difference of opinion exists about the proper use of the terms "approach" and "connection," applied to roadways adjacent to or leading toward a fixed river crossing. For the purposes of this paper the two terms are defined as follows:

The word "approach" refers to the roadway joining the crossing with the surface of the natural terrain, usually on divergent or convergent grades, and accommodating crossing traffic only, access to flanking or contiguous properties or highways being prevented by structural features, strips of marginal real estate, or traffic regulations. The word "connection" refers to a roadway leading to an approach, accommodating crossing traffic in addition to functioning as a normal highway, parkway, or street, providing service to flanking or continguous properties and access to intersecting highways. In short, an approach serves crossing traffic only and a connection serves other traffic in addition to crossing traffic.

As shown in Fig. 1, the Triborough Bridge has three approaches—one in the Borough of the Bronx, one in the Borough of Queens, and a compound one in the Borough of Manhattan. The ends of these three approaches in the past would have indicated the limits of the project, but in this case adequate and attractive connections have been provided to induce, accommodate, assemble, and distribute crossing traffic. The approaches serve to usher, and the connections to invite the prospective, and speed the parting—and in this instance the paying—guest.

In acknowledgment of the fact that highways used as connections will serve other traffic in addition to that which crosses the bridge, the City of New York paid 65 per cent of the cost of real estate taken in widening certain highways, which were part of the street system of the city, and dedicated the use of such streets as connections. The Triborough Bridge Authority paid for all construction costs on approaches and connections; it also acquired all the real estate necessary for the approaches, and in addition paid the remaining 35 per cent of the cost of the real estate previously referred to as necessary for widening the highways to serve as connections.

THE BRONX CONNECTION

In order to provide a direct path for bridge traffic in the Borough of the Bronx, the Triborough Bridge Authority is improving existing highways in a direct route to Pelham Bay Park. The present simple approach (Fig. 2) has been planned so that it can be modified, ultimately, to a compound one with a pair of simple ramps to serve the eastern connection and a curving central roadway to accommodate traffic on a contemplated connection for traffic in the western area of the borough. This future westerly approach will terminate in the block east of St. Ann's Avenue, between East 134th and East 135th streets, at which point it will meet the surface of the western connection.

The Bronx approach, as being constructed, is a wide ramp parallel to Cypress Avenue, passing over East 133rd Street and terminating at the south side of East 134th Street at the junction of Southern Boulevard and Cypress Avenue. True to the definition, this approach can serve bridge traffic only.

The Bronx connection begins at the end of the approach and utilizes Southern Boulevard to Whitlock Avenue, a distance of one-half mile. This thoroughfare is 100 ft in width, with a 60-ft roadway occupied by two trolley tracks. To free the connection of continued trolley-car interference, Whitlock Avenue,

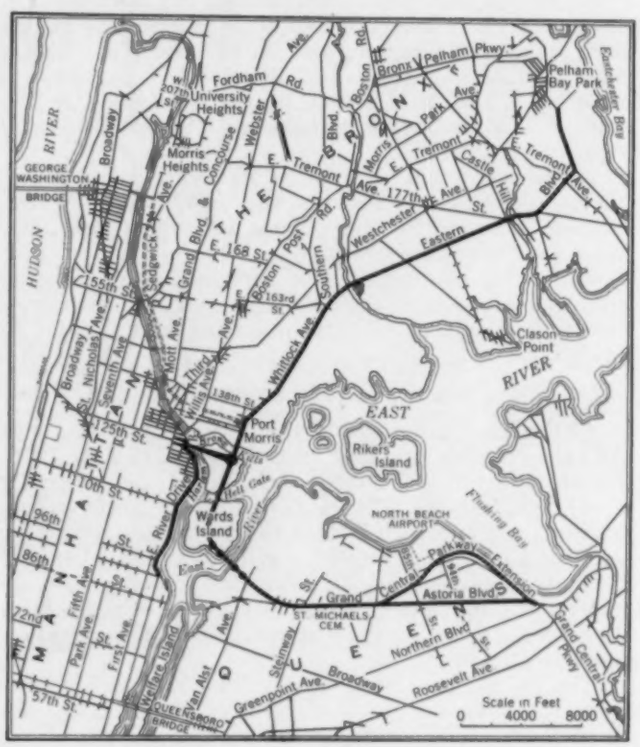

FIG. 1. PART OF NEW YORK, N.Y., SHOWING TRIBOROUGH BRIDGE AND CONNECTIONS

100 ft in width and 60 ft between curbs, is used from Southern Boulevard to Leggett Avenue.

From Leggett Avenue to Hunts Point Avenue, Whitlock Avenue was a 60-ft street and a 30-ft roadway carrying one-way traffic. A strip of private property 110 ft wide was acquired in this section, to permit the creation of a boulevard 170 ft in width, having two 15-ft sidewalks and two 40-ft roadways separated by a 60-ft mall, which affords an opportunity for decorative planting and treatment.

FIG. 2. BRONX APPROACH, WITH BRONX KILL CROSSING ON THE LEFT AND HARLEM RIVER CROSSING ON THE RIGHT

The connection continues on Whitlock Avenue to Eastern Boulevard as a 100-ft street with a 60-ft roadway. Eastern Boulevard is then followed to Pelham Bay Park. This is a 100-ft street with a 60-ft roadway, restricted only at the crossing over Westchester Creek, which provides for a 40-ft roadway.

In general this connection permits the assembly and dissemination of bridge traffic at all intersecting streets and main traffic routes, and an extension to Pelham Bay, Hutchinson River, and Bronx River parkways is expected. The total length of the connection is $6\frac{1}{4}$ miles. The roadway is surfaced with asphalt laid on a 6-in. concrete base.

In the event that standard traffic-light control causes undue congestion or restricts the capacity of the connection, a comprehensive scheme for a central express roadway flanked by two marginal streets has been proposed. This roadway will be depressed or elevated at principal transverse thoroughfares but will remain a connection, since it will carry other traffic in addition to bridge traffic.

THE MANHATTAN CONNECTION

At the Manhattan end of the bridge, a pair of ramps join the crossing structure with the grade of East 125th Street, one for "off-bound" traffic and the other for "on-bound" traffic. These ramps are generally recognized as one approach in that they terminate where the gradients meet the present surface between First and Second avenues (Fig. 3). Private property was acquired on both sides of East 125th Street from the river to Second Avenue for these ramps, and to afford areas for park treatment.

The second part of this compound approach crosses over the on-bound ramp of the East 125th Street approach and curves east to contact the surface at the foot of East 122d Street, at which point the connection begins.

The Manhattan connection, which has been called the East River Drive, is a new highway extending from 122d Street to 92d Street, at which point continuity to the south is accomplished by York Avenue—part of the present street system of Manhattan. It parallels a new bulkhead wall along the East River, the usual slip-and-pier development having been discarded. Slips extending inshore from the bulkhead line are being filled, and piers extending outshore are being demolished.

Sufficient waterfront property was acquired to provide a drive 125 ft wide, subdivided into a 15-ft sidewalk on the inshore side and two 32-ft roadways separated by a 6-ft mall, as shown in Fig. 4. The outshore 40 ft is dedicated to a decorative esplanade.

This connection intercepts all streets at grade and permits right turns for southbound traffic at all streets. For northbound traffic, turns are permitted only at 92d, 96th, 106th, and 116th streets, all of which are left turns.

The Manhattan connection, true to the definition, serves both bridge and other traffic. It is about $1\frac{1}{2}$ miles long, is paved with sheet asphalt on a 9-in. concrete base, and is lighted by two-fixtured central lighting standards.

THE QUEENS CONNECTION

The approach in the Borough of Queens ends midway between 28th and 29th streets and is flanked by Hoyt Avenue North and Hoyt Avenue South, the combined width of all roadways forming a plaza-like area 258 ft in width between curbs. This area, although adequate to handle all bridge traffic, is removed from direct feeder highways. In conformity with the facilities being provided in the other boroughs, connections are being constructed to cater to toll-paying trans-river traffic.

The Queens simple approach is served by a dual or compound connection, one part of which consists of a depressed express roadway approximately 1.1 miles long with eight traffic lanes, four in each direction, and a central mall 6 ft wide. Referring to Fig. 5, it will be seen that this express connection descends from the street surface adjacent to the approach to pass beneath 31st Street (Second Avenue) and continues as a depressed roadway to 49th Street, at which point it rises to meet the street surface at 70th Street, in front of St. Michael's Cemetery. For a distance of $\frac{1}{4}$ mile farther, the

FIG. 3. THE MANHATTAN APPROACH IS COMPOUND
View of Approach, Looking East from Second Avenue

express highway is at the same grade as the street system, permitting interchange of traffic.

Extending toward the east with a width of six traffic lanes divided by a central mall, the express connection descends to pass beneath the westbound roadway of Astoria Boulevard and continues northeast as Grand Central Parkway Extension until it reaches Flushing Bay. Thence it continues along the shore to the intersection of Astoria and Northern boulevards. It passes beneath these highways and continues southeast along and adjacent to Flushing River, the site of New York's coming world's fair. At the intersection of Northern and Astoria boulevards, a complete system of flying junctions permits free interchange of traffic between routes.

The Triborough Bridge Authority is constructing that part of the Grand Central Parkway west of the flying junctions. The total distance from the approach through the express roadway and along this section of the Grand Central Parkway Extension is slightly more than four miles.

The second part of the compound connection consists of two one-way marginal surface roadways, which flank the depressed express roadway and constitute integral parts of the Queens street system. These streets, Astoria Boulevard North and Astoria Boulevard South, are created by widening Astoria Avenue. Each provides a 15-ft sidewalk on one side and in general a four-lane roadway. They are cross-connected at 31st Street (Second Avenue) and at 35th, 37th, Steinway, 44th, 47th, and 49th streets, and form an interchange basin with the express roadway in front of St. Michael's Cemetery.

East of the cemetery the boulevards underpass the Grand Central Parkway Extension, and then converge at 80th Street to form a 130-ft surface boulevard made possible by the continued widening of Astoria Avenue. This boulevard, subdivided into two 15-ft sidewalks, two 42-ft roadways, and a 16-ft mall, extends eastward to 112th Place, a distance of $3^1/_4$ miles. Reconstruction east of 112th Place is being done by the Long Island State Park Commission in conjunction with the Grand Central Parkway Extension.

In constructing the depressed express roadway it was necessary to underpin the columns of the elevated railroad structure located on 31st Street (Second Avenue).

As real estate is too expensive to provide flying junctions between 29th and 33rd streets, and left turns into 31st Street are inconvenient and hazardous because of the elevated railroad columns, a left-turn basin has been provided east of 31st Street. This is situated in the triangular area between the two marginal highways, with a left-turn bridge over the depressed roadway.

FIG. 4. VIEW LOOKING NORTH ALONG THE EAST RIVER DRIVE, MANHATTAN CONNECTION

FIG. 5. ONE DEPRESSED AND TWO SURFACE HIGHWAYS MAKE UP THE COMPOUND QUEENS CONNECTION

Ramps are provided between 33rd and 35th streets to permit interchange of non-bridge traffic between the surface and the depressed roadways. At Steinway Street the valves controlling the Board of Water Supply's distribution system require that the eastbound and westbound roadways of the depressed express highway be divided in order to pass around the enclosing shaft.

East of Steinway Street the tracks of the New York Connecting Railroad cross both the express and the marginal roadways on an elevated structure resting on concrete piers, as shown in Fig. 6. The bases of these piers were originally above the bed of the depressed roadway, and it was necessary to support the trusses on falsework while removing the piers and installing new permanent supports.

Between the 44th and 47th street bridges over the express roadway, provision was made for a future flying junction with a high-speed connection to Queens Boulevard.

The Grand Central Parkway Extension is to be given landscaped treatment similar to that of the Grand Central and Northern State parkways. Ornamental overhead bridges are installed at Astoria Boulevard (westbound), 85th Street, and 94th Street, the latter carrying trolley tracks. Along Flushing Bay the inshore upland is to be landscaped in conformity with existing conditions.

This part of the Grand Central Parkway will consist of a broad esplanade to be built along the waterfront on ground made by hydraulic fill from the bottom of Flushing Bay. It will be protected by a sea wall. The rest of the made area will be dedicated to park and recreational purposes. In addition to serving as a bridge connection this highway will permit high-speed motor shuttle service between Glenn Curtis Airport and Manhattan.

There will be three pedestrian overpasses of the express highway at convenient points.

The plans of the Grand Central Parkway connection, the locations of parks and playgrounds, and the landscaping and structural treatment were in charge of the Long Island State Park Commission and the New York State Department of Public Works.

Construction of the westerly section of the Queens connections required major changes in the existing street system and a modification of the sewer system. The new sewer system enlarges the present facilities in order to accommodate the flow from a drainage area to be equipped with sewers in the future. Between 31st and 32d streets the depressed roadway is below the invert of the adjacent sewer. It was therefore necessary to install an automatic pumping station in order to remove storm water collecting at this low point.

FIG. 6. THE QUEENS CONNECTION PASSES BENEATH THE TRACKS OF THE NEW YORK CONNECTING RAILROAD EAST OF STEINWAY AVENUE

The water mains serving the territory were rerouted along the marginal streets and through the decks of the bridges over the depressed roadway connecting the streets. Major changes were made in the valve chamber of the water-distribution system at Steinway Street.

The overhead facilities of the utility companies were relocated in new underground systems, and their existing subsurface structures required relocation at many points.

This extensive relocation work was planned in such a way that service to the public would not be unduly interrupted. To this end close cooperation was maintained with the Brooklyn Union Gas Company, Consolidated Gas Company, New York Telephone Company, New York and Queens Electric Light and Power Company, and the Steinway (trolley) Lines.

On the $6\frac{1}{4}$ miles of Queens connections, three different types of roadway construction are used. The depressed roadway is a 10-in. double-reinforced concrete slab on a 6-in. cinder base. The Grand Central Parkway connection is paved with 8 in. of reinforced concrete. Astoria Boulevard and the marginal Astoria Boulevard North and Astoria Boulevard South are paved with sheet asphalt on an 8-in. unreinforced concrete base.

The legislative act authorizing the Triborough Bridge stipulated that facilities should be provided for vehicular access between the bridge and Randall's Island. This requirement made the junction a particularly interesting problem, as the three branches of the bridge necessitated flying junctions for six main traffic movements. In order to make Randall's Island accessible from the three boroughs, the number of traffic routes to be provided for was increased to 12. The decision to collect tolls at the island further increased the complexity of the problem.

RANDALL'S ISLAND JUNCTION

A unique plan for the junction was developed from the usual grade-separation solution, permitting continuous and speedy movement along all 12 routes—with a stop for toll payment—free from steep grades and sharp curves. This plan is shown in Fig. 7.

The ramps leading to Randall's Island are approaches rather than connections because the traffic handled by them is bridge traffic. They will make available to the public an island converted to recreational uses. Playgrounds, parking areas, and a stadium will all be provided. By means of a low-clearance bridge over Little Hell Gate, the island will be connected with Ward's Island, which will be similarly reconditioned in a few years.

Although the Triborough Bridge Authority is primarily constructing a transportation link between the three boroughs, it is also demonstrating that a utilitarian project may become an asset to the metropolis by providing playgrounds, parks, and landscaping.

The cooperation which made this achievement possible is due to the fact that Robert Moses, in addition to being a commissioner of the Triborough Bridge Authority, is also Commissioner of Parks of the City of New York, president of the Long Island Park Commission, and president of the Council of State Parks. Detailed plans for the varied work along the connections were prepared by the city departments.

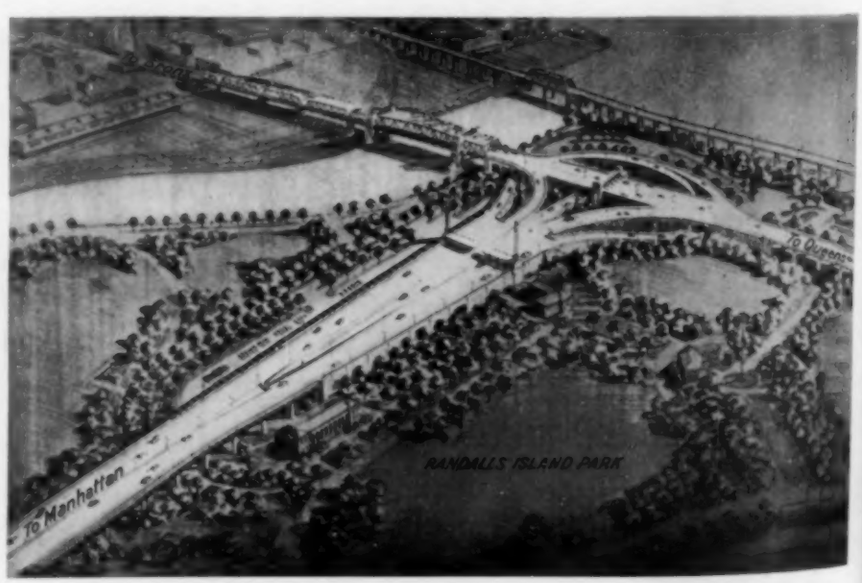

FIG. 7. RANDALL'S ISLAND APPROACHES, SHOWING FLYING JUNCTIONS FOR SIX MAIN TRAFFIC MOVEMENTS AND ARRANGEMENTS FOR COLLECTING TOLLS

Sanitary Engineering Division Committees

Technical Groups Make Reports at Division Session on January 16, 1936

Committee on Chemical Treatment of Sewage

Abstract of Preliminary Statement

The past few years have witnessed a revival of interest in sewage disposal by chemical treatment processes. This has come about as the result of a search for an economical form of treatment ranging in degree between that of plain sedimentation and the biological processes. Until recently the symposium on "Sewage Treatment by Modern Chemical Methods" (Civil Engineering, April 1935) constituted the most complete and up-to-date published statement on this subject.

Not long after the establishment of the present committee, it was learned that the Committee on Sewage Disposal of the American Public Health Association, headed by a member of this Division (Langdon Pearse, of Chicago), had under way the compilation of a report on "Chemical Treatment of Sewage." Realizing the thoroughness with which the A.P.H.A. committee planned to review the history and existing literature on the subject, and to avoid duplication of effort and purpose, it was considered advisable to await the appearance of the Pearse report before proceeding.

This outstanding report on "Chemical Treatment of Sewage," which has proved to be as thorough as anticipated, was submitted on October 8, 1935, to the A.P.H.A. in annual meeting at Milwaukee, Wis. It has since appeared in full in the *Sewage Works Journal* for November 1935, and its reading and study is recommended to members of this Division.

Operating data from full-scale plants and various experimental installations are as yet too meager to justify presentation of definite conclusions as to the effectiveness and economy of the several processes employed. A review of the information now available, however, would seem to justify the following conclusions:

1. Adoption of a chemical treatment process in any particular case should be based on a critical study of all local conditions to be met.

2. The degree of purification effected with normal sewages, employing practical dosages of chemicals and moderate periods of flocculation, will lie between that secured by plain sedimentation and efficiently performing biological processes.

3. Experimental installations when utilizing long periods of flocculation in combination with the recirculation of a portion of the sludge, indicate that it may be possible to secure dependable and consistent degrees of purification closely approaching those of the biological processes.

4. The use of chemical treatment processes may find most suitable application, as follows:

a) For sewage carrying toxic industrial wastes or non-toxic wastes in high ratios to the domestic sewage.

b) In locations where it is necessary to supplement primary treatment (sedimentation) for part of the time only.

c) As preliminary treatment, where it is necessary to relieve an overload on existing works.

d) As complete treatment, where space limitations or inadequate funds prevent the construction of more complex and extended works.

5. The operating costs at full-time chemical treatment plants (considering the present status of the cost and availability of chemicals) may in many cases exceed the operating costs of biological plants of the activated sludge type—especially those which produce power from digester gas or where power costs are low.

Respectfully submitted,

Richard H. Gould, *Chairman*

William R. Copeland	Theodore R. Haseltine
H. J. Darcey	Harry H. Hendon
Linn H. Enslow	George J. Schroepfer

Committee on Filtering Materials

Abstract of Final Progress Report

The activities of the committee have been covered by many meetings and the presentation of 10 progress reports, including considerable detail data which have been of much general interest. The personnel of the committee has remained the same during its 10 years of activity.

The final reports of the committee, relating to filtering materials for sewage works, for both trickling filters and fine-grain filters, are now in the hands of the Committee on Publications of the Society, and will be combined and published as a manual of engineering practice.

An extended investigation on filter sand for water works, under the direction of Mr. Armstrong, with the cooperation of the filtration departments of 26 cities, has been completed, and a report prepared. This report is being presented to the Executive Committee of the Sanitary Engineering Division, with the suggestion that it be published by the Society as a monograph.

The committee believes that it has completed the work assigned to it and requests that it be relieved from further duty.

Respectfully submitted,

William E. Stanley, *Chairman*

James W. Armstrong	George B. Gascoigne
W. H. Dittoe	Nathan T. Veatch, Jr.

Committee on Technical Aspects of Refuse Disposal

This committee, appointed in 1935, is expected to stimulate and develop, by studies, reviews, and discussions of refuse collection and disposal problems, a more adequate and impartial engineering basis for this field of sanitation. Its personnel, in addition to the chairman, Harrison P. Eddy, Jr., consists of Herman G. Baity, Herman P. Cortelyou, Frank E. De Martini, Walter Frickstad, Harry Goodridge, and Leon G. Williams.

Abstract of First Progress Report

This report will be limited to a preliminary statement of methods of refuse disposal in current use in this country and in Europe. Before discussing the various

methods of disposal, however, the materials included under the heading of refuse will be defined.

Garbage. "Garbage is the solid animal and vegetable waste matter produced wherever food is handled raw or prepared for consumption. A distinction is often made between house garbage, restaurant garbage, market garbage, and trade garbage. The terms *swill*, *slops*, and *offal* are frequently used synonymously with the term garbage. The word *offal* is perhaps better applied only to the solid animal wastes originating in markets and slaughterhouses. The word *swill* describes the more liquid wastes originating in kitchens. The word *slops* describes liquid wastes such as dishwater."[1]

Rubbish. Rubbish is "waste material, such as newspaper, wrapping paper, boxes, cans, crockery, rags, rubber, leather, wood, brick, glassware, tinware, and lawn and brush clippings, much of which material is combustible."[2]

Mixed Refuse. "Mixed refuse is a term used in this country to include garbage and rubbish, but not ashes."[2]

Ashes. "Ashes as collected in municipalities commonly have mixed with them more or less rubbish, especially tins and bottles, and frequently some garbage, but the major portion of this material consists of household wastes."[2]

Generally the above refuse materials are not thoroughly separated and each may contain small quantities of the others.

Street Sweepings. "Street sweepings consist of the refuse which accumulates on the surfaces of streets and sidewalks, including the droppings of horses and other animals, miscellaneous litter thrown upon the streets, material carried by wheels from unpaved to paved streets, leaves, and sweepings from buildings and sidewalks."[2] Frequently the contents of sidewalk and park rubbish receptacles are included under this term instead of under rubbish.

Generally municipal disposal works must also care for large numbers of dead animals.

PRESENT STATUS OF REFUSE DISPOSAL IN THE UNITED STATES

There are many different methods of refuse disposal in use in the United States, some applicable to one class of refuse and others to two or more classes of refuse.

Destructive Distillation. For many years occasional experiments have been made with the destructive distillation of garbage for the recovery of gas, charcoal, tar products, and alcohol. No such process is known to be regularly in use at the present time.

Digestion with Sewage Solids. In a few cases, as at St. Louis, garbage has been ground and discharged into sewer manholes for transportation with sewage, and patents for the process have been issued.

Beccari Process. The Beccari process has been in use in Italy for a number of years, and also in this country at Scarsdale, N.Y., and a few municipalities in Florida. This plan provides for storing the garbage in ventilated enclosed racks for a number of months, during which time it is subject to fermentation caused by living organisms.

Dumping Into the Sea. A few cities situated on the seacoast dispose of their garbage by dumping at sea. This is said to be done satisfactorily on the Pacific Coast in three cases. Much of the garbage, rubbish, and ashes of New York City was disposed of in this manner until recently. This practice in New York has now been stopped permanently by order of the U. S. Supreme Court.

Dumping Into Rivers. Beginning early in 1935, the garbage of the City of St. Louis has been ground and discharged into a sewer, through which it is carried by the sewage to the Mississippi River. It is reported that this process has been investigated by the U. S. Army Engineers and approved for St. Louis. This is the only case of which the committee has knowledge in which the garbage is reduced to fine particles before its discharge into bodies of water. Dumping of refuse into rivers is of course a method in common local use in the case of individuals and manufacturing plants.

Burial of Garbage. The committee has no knowledge of any municipality in which burial of garbage is practiced as an organized municipal activity. In the city of Worcester, however, this method is practiced for the disposal of uneaten garbage, pig manure, and bedding at the municipal hog farm.

Filling Waste Land. Where refuse is used for filling waste land without attempt to cover the freshly placed refuse, the process is known as disposal by filling. It is used in many communities for all classes of municipal refuse.

Fill and Cover, or Sanitary Fill. In a few cities on the Pacific Coast, the fill-and-cover method, or sanitary fill, has been used. This method consists of depositing refuse to a depth of several feet and covering the fresh fill with a layer of earth, ashes, or other inert material, about 2 ft in depth.

Feeding Garbage to Hogs. Hog feeding continues to be by far the most widely used method of garbage disposal. It should be borne in mind that it is not a method of complete disposal. The uneaten garbage, manure, and bedding aggregate in weight about one-third to one-half of the weight of the raw garbage delivered to the farm. The residue is much more offensive than the original material.

The residue may be disposed of either by plowing it into the soil as a fertilizer as soon as it is produced, by storing it in compost heaps for subsequent use as fertilizer, or by burial. With any of these methods the dissemination of odors is likely, unless extreme care is exercised. A method of disposal of residue which the Chairman has used in a full-size experiment and which has been considered for several large-scale projects is an adaptation of the reduction process. Another method which has been considered is incineration with municipal rubbish, the latter providing the additional heat required.

Reduction of Garbage. In the reduction process as generally practiced, garbage is cooked for a number of hours under steam pressure in closed vessels. The moisture is partly removed, either by pressing or by evaporation. The grease is recovered from the liquor or from the solid matter by extraction, and the solid matter is dried. One of the by-products of this process is grease of a grade suitable for soap and candle making and for the recovery of red oil for use in the textile industry. The solid matter is available as a base for fertilizers.

There are 14 garbage reduction plants in operation at the present time, using municipal garbage.

Incineration. Incineration is a process of burning garbage, rubbish, or mixed refuse, either with or without the other types of municipal refuse—ashes, dead animals, and street sweepings. If a temperature in excess of 1,250 F is maintained continuously, the gases of in-

[1] From Final Report of Committee on Collection and Disposal of Garbage, Sanitary Section, Boston Society of Civil Engineers, 1927.

[2] From American Civil Engineers' Handbook, 1930, page 1749.

cineration will be effectively deodorized. Garbage of itself lacks heat value sufficient to evaporate its high moisture and to maintain such temperatures. The additional heat required may be provided by means of coal, oil or wood or, as is generally the case, by means of municipal refuse. There are probably between 650 and 750 incinerators serving municipalities in this country and Canada at the present time.

Present Trends in Disposal Methods. Until the rise in pork prices of the last two years, there appeared to be a definite interest in changing from hog feeding to incineration. The high price of pork has tended to check this trend, although the greatest check is due to the present economic situation of our municipalities.

In the first PWA program 12 municipal incinerators were included, with an equal number in the second program. There is active interest in the construction of a number of additional incinerators.

While there is much discussion among sanitary engineers in regard to the disposal of garbage with sewage, it cannot be said that there is any marked trend toward adopting this method of disposal on the part of the municipalities.

PRESENT STATUS OF REFUSE DISPOSAL IN EUROPE

The most important feature to consider when comparing refuse disposal methods in Europe with those in this country is the difference in character of refuse. In most of western Europe all waste is stored in one container in the household. On this account the refuse becomes a mixture of what we know as garbage, rubbish, and ashes. The characteristics of this material differ also because of the difference in climate and in habits of the people in the two hemispheres. Perhaps the inclusion of the ashes with the garbage and rubbish causes the greatest difference in character. For example, in England the material is frequently referred to as "dust."

Perhaps the most interesting method of disposal in Europe is controlled tipping, which is used extensively in England and to a lesser degree elsewhere. The practice in controlled tipping is laid down quite definitely by the Ministry of Health in its tipping precautions issued in 1922. Quoting from an article by J. C. Dawes, Inspector of Public Cleansing of the Ministry of Public Health:

"Very briefly, the underlying principles require dry refuse to be deposited in shallow layers not more than 6 ft in thickness and wholly covered in 24 hours with soil or other non-combustible material, so as to form an effective seal. The whole of the refuse can be put into the tip, but it must be packed very carefully. There must be no cavities. The front of the tipping face must be kept narrow, where practicable not more than 20 ft, to facilitate daily covering."

This is a biological process in which a temperature of fermentation of 150 F is aimed at for a period of 20 to 30 days, although considerably higher temperatures have sometimes been reached. When reference is made to "careful packing of the refuse," this means actual flattening-out of paper cartons and tin cans and breaking of bottles, a procedure which, if done by hand at American labor rates, would be expensive.

In many municipal installations, before incineration, the refuse is passed through screening equipment for removal of the large amount of fine (less than $^5/_{16}$-in.) dust, which in London runs as high as 28 per cent in winter. In some cases the fine material is used on heavy land, where its value for lightening the soil may be perhaps more important than its fertilizing value, and in other cases for making the "London stock" brick. The removal of this material effects a substantial economy in the equipment for incineration, by reducing the capacity required, and perhaps a greater economy in the cost of operation of the incinerator.

In England there is a pulverizing process in which the entire refuse except metals is put through a hammer-mill crusher, the residue being used on farming land. It is said that the cost of grinding is about $1 per ton, to which must be added the transportation from the grinding plant to the farm. Grinding and subsequent use for agriculture are practiced also in Italy. In the latter country there appears to be considerable interest in agriculture, in the use of fermenting refuse, either with or without grinding, from the standpoint of warming otherwise cold, damp soil, as well as lightening the soil.

Disposal at sea in Europe is not generally looked upon with favor.

COMMITTEE ON WATER SUPPLY ENGINEERING

THE ANNUAL progress report of this committee is to appear in the March 1936 issue of PROCEEDINGS under the title, "Water Supply Engineering." The members of the committee are T. H. Wiggin, chairman; F. A. Barbour, John R. Baylis, William W. Brush, L. R. Howson, and Jeptha A. Wade.

COMMITTEE ON SLUDGE DIGESTION

THE COMPLETED REPORT of this committee is in process of preparation for publication as a manual of standard practice. Committee personnel consists of Samuel A. Greeley, chairman; W. L. Havens, C. B. Hoover, C. E. Keefer, and John F. Skinner.

COMMITTEE ON SEWER RENTAL LAWS AND PROCEDURE

THIS COMMITTEE, newly organized, has begun assembling data for its study of the provisions and the results of operation of existing sewer rental laws. It is intended that the committee shall encourage the enactment of such laws and recommend, as far as may be practicable, uniform standard laws for all states. The chairman is F. H. Waring, and Earl Devendorf, W. D. Hatfield, Leon B. Reynolds, and Earle L. Waterman are members. James A. Tobey, not a member of the Society, is serving in an advisory capacity to the committee.

COMMITTEE ON WATER TREATMENT RESEARCH AND PLANT DESIGN

THE COMMITTEE submitted a detailed outline of a contemplated manual of standard practice on water treatment plant design. The topics to be considered have been subjected to the criticism of the individual members of the committee, and a general agreement has been reached relative to the various subjects on which monographs are to be written. The committee consists of Joseph W. Ellms, chairman; James W. Armstrong, Joseph D. De Costa, John F. Laboon, Arthur L. Reeder, and F. H. Stephenson.

The paper by Stanley M. Dore, entitled "Permeability of Foundations for Earth Dams," which was presented before the Sanitary Engineering Division on January 16, 1936, is to appear in full in the March issue of PROCEEDINGS. *For that reason, the customary abstract has been omitted from this issue of* CIVIL ENGINEERING.

A New Field for Sanitary Engineers

Opportunities Opened to Them by the Development of Industrial Sanitation Deserve Consideration

By Charles L. Pool
Associate Member American Society of Civil Engineers
Sanitary Engineer and Chemist, Rhode Island Department of Public Health, Providence, R.I.

Whatever the facts in the West Virginia silicosis case now being investigated in Washington, the investigation itself is additional evidence of the increasing attention being given to the importance of industrial sanitation. Other examples are constantly arising, almost as great in variety as in number. The field of industrial sanitation, says Mr. Pool, lies on the border line of that of the sanitary engineer, and there are many parts of it he well might enter. That he has not already done so to any appreciable extent is largely due to a lack of organized information on the subject—a lack that Mr. Pool suggests might be remedied by the Sanitary Engineering Division of the Society. Other steps that the Division might take in making this field available to the sanitary engineer are also outlined. This article is abstracted from a paper presented before the Sanitary Engineering Division at the Annual Meeting of the Society on January 16, 1936.

Although the sanitary engineer has contributed immeasurably to the advancement of municipal and public sanitation in the last decade or two, he has done nothing comparable in the field of industrial sanitation. The scope of the rôle he should assume in the latter field deserves serious consideration at the present time.

The present status of industrial sanitation is not especially creditable. Not even in the sanitary engineering specialties of water supply and disposal of wastes does it approach that of public sanitation. And when it comes to protection of workers against harmful dusts, fumes, devitalizing exposures, and inadequate ventilation or illumination, the picture is one of a vast but scattered body of technical and engineering knowledge that has only begun to be widely applied. In spite of the great advances in the medical phases of industrial hygiene, it is stated from authoritative sources that workers, because of industrial hazards, have five years cut off from their average life span as compared with those of similar economic status employed in non-hazardous occupations.

This, with all it implies, indicates a widespread inadequacy in the application of protective measures still to be overcome largely by the application of engineering knowledge. Although the failure to apply this knowledge is partly the result of inherent difficulties, it is in the main attributable to a lack of organized direction. In a paper presented at the last annual meeting of the American Public Health Association, it was suggested that sanitary engineers, who comprise the backbone of the public health engineering profession, might extend their influence to improve the situation. But to what extent should they participate? Should they also, as a body, attack more comprehensively the problems of industrial sanitation just outside the scope of public health, such as property damages caused by the escape of industrial dusts and fumes into residential districts?

Health authorities have recommended that public health engineering increasingly embrace the engineering aspects of sanitary engineering, hygiene, biostatistics, epidemiology, health administration, common law, sanitary laboratory, food and milk technology, entomology, housing, industrial sanitation, and rural and recreational sanitation. Some engineers have thought these recommendations so broad as to compel shallowness, but public health engineering encompasses this heterogeneity, whether sanitary engineers are to undertake the whole or only a part of it. Special training would be required for most individual sanitary engineers to meet the recommendations fully, but the scope of a profession need not be limited to that of an individual member of it. Moreover, upon examination the list is less formidable than it appears at first sight. Orthodox training in sanitary engineering includes the basic elements of much of it. Of all the subjects listed, industrial sanitation leads the public health or sanitary engineer farthest afield from water supply, disposal of wastes, and his other more common activities; moreover, to a greater or less extent it includes most of the other items. The Sanitary Engineering Division, therefore, in considering whether it should deliberately aid the expansion of sanitary engineering into the newer technical applications of industrial sanitation, should contemplate the border lines of the profession as a whole.

Let us take an example. The Rhode Island State Department of Public Health was recently asked to investigate a complaint of sickness and nuisance in a residential area ascribed to stack discharges from one factory. The stack to which most objection was made emitted voluminous fumes from an industrial process. A second stack discharged combustible material from a fire under an ordinary large boiler. A third discharged dust. Now none of these discharges could have caused sickness, but a nuisance did exist. The fumes, which alone had been investigated previously, were found to deserve only third place in importance. The combustion of the boiler fire was inefficient; the dust collection equipment had arrived at zero efficiency and was out of service being overhauled. The nuisance was surmountable. The processes producing the dust revealed an engineering problem for protection of the workers' health.

To what extent is this composite example a public health engineering problem, and how far should a sanitary engineer contribute towards its solution? If necessary it could be shunned by the public health engineer, because the health of the public is not at stake and the nuisance is a matter for private adjustment among the parties concerned. The health of the workers in this case, according to interpretations of Rhode Island statutes, is primarily the concern of the State Department of Labor—which has as yet no personnel trained to attack the problem of dust in workrooms. Yet should not the public health engineering facilities be applied to the betterment of conditions simultaneously for residents, employers, and employees?

The public health engineering facilities in this case comprehend some of the data needed, and the rest are obtainable. At least, unified direction can be given to a problem which calls for specialists, one on combustion, and one on determination of dust in workroom atmos-

pheres and its reduction to reasonable standards set by medical and engineering research. In such problems where specialists cannot be afforded, should not the public health engineer advise as fully as he can?

There would seem to be a field of useful work along such lines waiting to be developed by sanitary engineers. Do not the limitations of the sanitary engineer in regard to these problems result mainly from insufficient familiarity with what is practicable? Would not a great many such problems, now side-stepped as being not the specialty of the sanitary engineer, be solvable by him if the proper information were readily available?

Publication by the Society (in PROCEEDINGS for May 1925) of the symposium on odors prepared by the Sanitary Engineering Division is evidence that the assembling of such information has not been completely ignored. But it has been neglected. More material of this type should be condensed into a form readily available to and usable by the sanitary engineer from such scattered sources as medical, chemical, heating and ventilating, industrial, public health, labor, insurance, safety, and research publications, and from contributions of individuals with experience in these fields.

The determination of exposure to dust in workrooms and the elimination of such hazards as may be determined is analogous to the determination of the bacteriological quality of water and its control. Sampling of air is fairly well standardized and is easily within the grasp of the sanitary engineer. So is the control of hazardous fumes. Examples of industrial sanitation could be multiplied to show how basic principles of sanitary engineering could be applied to good purpose up to a point where the problems become medical or chemical.

There are relatively even fewer men training themselves as industrial sanitarians than as sanitary engineers. The demand for specialists in industrial sanitation will probably exceed the supply, and the gaps will be filled by technical men primarily trained for something else. But if an industrial sanitation specialty were built on a broader base, which would enable a man to practice in the general field of sanitary engineering, would not both the specialty and the sanitary engineering profession itself be strengthened?

The advancement of the engineering aspects of industrial sanitation and the support of individuals attempting to practice them are not adequately fostered by any large professional society. There is nothing behind the engineer comparable to the weight of professional organization back of the medical practitioner of industrial hygiene. The engineer has not the opportunity to draw upon a body of authoritative formulated practice such as is available to the medical man.

Addressing the Sanitary Engineering Division at the 1935 Annual Meeting, A. C. Decker, M. Am. Soc. C.E., showed the usefulness of the sanitary engineer in the large industrial organization ("The Rôle of the Sanitary Engineer in Industry," in CIVIL ENGINEERING for April 1935). If this rôle could be extended would there not be a wider field in medium-sized organizations, industrial and governmental?

It has not been possible here to do much more than state the problem; the answer should not be attempted by a single individual. But if it is the consensus of opinion that the scope of sanitary engineering should be extended, several things could be done by the Division.

Recognition of an extended rôle for the sanitary engineer in industrial sanitation could be promoted. Not very many years ago it used to be necessary to explain, even to well-informed persons, what sanitary engineering meant. Now its meaning is so well accepted that the Mayor of New York, in order to achieve striking clarity, calls himself a political sanitary engineer. If the propriety of the extended rôle of the sanitary engineer were more popularly understood it would further his access to a variety of problems.

Members of this Division could be kept informed more adequately of the engineering aspects of industrial sanitation, and of the practicable methods which sanitary engineers might use to put themselves in a stronger position to advise those with whom they come in contact. Scattered engineering information available in technical terms not readily applicable by the sanitary engineer could be digested and assembled in convenient form.

Acceptable practices could be formulated so as largely

Courtesy Kadco Corporation

DUST HAZARDS OF ROCK DRILLING ARE EASY TO ELIMINATE With the Trap in Place, Dust Is Removed as Rapidly as It Forms. In Addition to Protecting the Worker, This Process Increases the Efficiency of the Point of the Drill

to relieve the sanitary engineer of the necessity of assembling and offering his own unsupported interpretations. At present his conclusions on, say, the adequacy of a water supply carry the weight of organized opinion, but his recommendations on the adequacy of dust-control measures might be assailable by others approaching the problem from a different set of primary considerations.

Influence could be exerted to include in the training of sanitary engineers problems of industrial sanitation. The inclusion in the field of sanitary engineering of many new phases of industrial sanitation could be fostered so that practitioners approaching from other angles problems which are basically in the general field of sanitary engineering would gradually be influenced to adopt sanitary engineering affiliations and the approach that has already proved successful in other problems involving chemistry, biology, and other sciences. Recognition of engineering and the participation of engineers in problems that involve cooperative effort with other professions could be enhanced by the support of organized engineers in their relationships with other professional groups.

That the sanitary engineer has a rôle in industrial sanitation has been taken for granted. That the scope of the rôle is as broad as it ought to be can be seriously questioned. The future scope probably depends more on what we make it than on any inherent limitations.

Classification and Compensation of Federal Engineering Positions

By JOHN C. HOYT

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AS a result of studies made under the auspices of various organizations, including those representative of engineers, a system of classification for Federal emyloyees was made effective in 1923. With subsequent enactments the government law has now been extended to apply to 164,000 federal positions, of which 64,000 are in the District of Columbia and 100,000 in the field. After long familiarity with these developments, Mr. Hoyt explains the allocation of positions in terms of class, service, occupational group, grade, and series. In particular he describes the application of these methods to engineering positions, giving the limiting salaries for various grades and classifications.

NEARLY twenty years ago the Engineering Council, then embracing the four Founder Engineering Societies, the United Engineering Society, and the American Society for Testing Materials, set up a committee on classification and compensation of engineers, which was divided into three sections corresponding to federal, state and municipal, and railroad groups of engineers. The federal section of the Council's committee made a study of 16 engineering bureaus in civil government establishments and 4 in the Navy Department, having an aggregate of 4,548 civilian engineering positions. A "position" was defined as a specific civilian office, employment, or job (whether occupied or vacant) calling for the performance of certain duties and the carrying of certain responsibilities by one individual, and a person temporarily or permanently assigned to a position was termed an "employee."

After this study a classification was proposed, based on the character of the work and the duties and responsibilities of each position and the qualifications necessary for an employee who could reasonably be expected to fill it satisfactorily. This classification divides positions relating to engineering into two groups—professional, with 5 grades; and subprofessional, with 2 grades. The classification enables the allocation of any position to a group that will show not only the type of work to be performed but the qualifications necessary for the employee to perform it and thereby provides a ready means for the study and intercomparison of positions on a uniform basis. It gives a basis for eliminating much of the confusion that results from the use of inaccurate payroll and other titles in the consideration of employment questions, a sound foundation for establishing pay scales, and an equitable means for the comparison of positions involving independent work with those involving administrative duties. It also indicates a direct line of promotion from grade to grade, based on changes in duties or responsibilities, and permits salary increases within grades, both for merit and for adjustments to meet other conditions that may arise within the grade.

SYSTEM DEVELOPED AND EXTENDED

The basic principles of the classification proposed by the committee of the Engineering Council were enacted into law March 4, 1923 (42 Stat., 1488). This law was liberalized by a joint resolution approved June 7, 1924 (43 Stat., 669), and by two amendments, one approved May 28, 1928 (45 Stat., 776), and the other approved July 3, 1930 (46 Stat., 1003).

This statutory classification was made effective July 1, 1924, when it was applied to positions in the executive departments and certain other federal agencies in the District of Columbia. At the present time over 64,000 positions in Washington come directly under the act.

The amendment of May 28, 1928, provided for a survey of the classes of civilian positions in the various field services, except in the Postal Service, and the Foreign Service, and certain mechanical and drafting groups, as a basis for extending the classification to field positions. Reports of this survey were submitted in 1929–1931 but on account of economic conditions were not acted upon by Congress. In general, however, the principles of the act have been administratively extended to over 100,000 field positions.

The federal classification system recognizes the grouping of individual positions under five headings: (1) service; (2) occupational group; (3) series, which relate to the character of work; (4) grade, which relates to the difficulty and importance of the work; and (5) class, which is determined by a combination of the factors that enter into the four other groups. These terms are defined below.

BASIS FOR RATING POSITIONS

Service. A general aggregation of positions grouped on some broad basis selected to aid in the process of classification and the fixing of compensation. The federal classification provides for five services: (1) professional and scientific; (2) subprofessional; (3) clerical, administrative, and fiscal; (4) custodial; (5) clerical-mechanical.

Occupational Group. The term is applied as a practical convenience to a major subdivision of a service, embracing positions in associated occupations, professions, or activities. The professional and scientific service of the Federal classification has 12 occupational groups, as follows: economic analyst, educationist, anthropologist, scientist, dentist, medical officer, veterinarian, engineer, attorney, director National Gallery of Art, librarian, and patent examiner.

Series. As an additional practical convenience, each occupational group is further divided into subgroups called "series," each of which includes all positions having to do with a specialized line of work. The federal classification system recognizes the following series, which will provide for most positions in the principal branches of the engineering occupational group: agricultural, architectural, chemical, civil, electrical, marine, mechanical, and mining. Other series are also provided for groups of positions relating to specialized engineering subjects, usually subordinate to one of the principal engineering series listed above.

Grade. The term is applied to a horizontal subdivision of a service, including one or more positions for which

approximately the same basic qualifications and compensation are prescribed, the distinction between grades being based on the difference in the importance, difficulty, responsibility, and value of the work. Nine grades have been set up for the professional and scientific service. They are designated by the general term "professional," with the following prefixes: junior, assistant, associate, full, senior, principal, head, chief, and special.

Class. The smallest logical grouping of positions is designated by the term "class" and includes those positions so nearly alike with respect to the character of the work (indicated by the service, occupational group, and series) and with respect to difficulty and importance of work (indicated by the grade) that (*a*) the same requirements as to education, experience, knowledge, and ability are demanded of incumbents; (*b*) the same tests of fitness are used to choose qualified appointees; and (*c*) the same schedule of compensation can be made to apply with equity. Junior hydraulic engineer, assistant hydraulic engineer, and associate geodetic engineer are typical classes.

For positions in which the duties are either subordinate or preparatory to the work required of employees holding positions in the professional and scientific service there is a subprofessional service having eight grades.

The grade definitions for the professional and scientific service and the subprofessional service, from Classification Statutes, U. S. Civil Service Commission, July 1935, are given in the following paragraphs. These definitions are greatly skeletonized in order to incorporate them in legislation. They express general principles. For practical application these principles have been expanded into detailed specifications accompanied by typical examples of duties from each grade, in order to facilitate uniform coordinated allocation of employees. These details are omitted here but can be obtained from the Civil Service Commission, Washington, D.C.

TABLE I. SCHEDULE OF ANNUAL SALARY RATES

Annual Salaries		Classification Grades			
Minimum	Maximum	CAF	CU	P&S	SP
$ 600	$ 840	..	1	..	..
1,080	1,380	..	2	..	..
1,200	1,500	..	3	..	..
1,020	1,380	..	..	..	1
1,320	1,680	..	4	..	..
1,260	1,620	1	..	..	2
1,500	1,860	..	5	..	..
1,440	1,800	2	..	..	3
1,680	2,040	..	6	..	..
1,620	1,980	3	..	..	4
1,860	2,300	..	7	..	..
1,800	2,160	4	..	..	5
2,000	2,600	5	8	1	6
2,300	2,900	6	9	..	7
2,600	3,200	7	10	2	8
2,900	3,500	8	..	..	..
3,200	3,800	9	..	3	..
3,500	4,100	10	..	..	..
3,800	4,600	11	..	4	..
4,600	5,400	12	..	5	..
5,600	6,400	13	..	6	..
6,500	7,500	14	..	7	..
8,000	9,000	15	..	8	..
Over 9,000 when authorized by express law		16	..	9	..

GRADE DEFINITIONS AND SALARY SCHEDULES IN FEDERAL CLASSIFICATION

"PROFESSIONAL AND SCIENTIFIC SERVICE

"The professional and scientific service shall include all classes of positions the duties of which are to perform routine, advisory, administrative, or research work which is based upon the established principles of a profession or science, and which requires professional, scientific, or technical training equivalent to that represented by graduation from a college or university of recognized standing.

"Grade 1 in this service, which may be referred to as the junior professional grade, shall include all classes of positions the duties of which are to perform, under immediate supervision, simple and elementary work requiring professional, scientific, or technical training as herein specified but little or no experience.

"The annual rates of compensation for positions in this grade shall be $2,000, $2,100, $2,200, $2,300, $2,400, $2,500, and $2,600.

"Grade 2 in this service, which may be referred to as the assistant professional grade, shall include all classes of positions the duties of which are to perform, under immediate or general supervision, individually or with a small number of subordinates, work requiring professional, scientific, or technical training as herein specified, previous experience, and, to a limited extent, the exercise of independent judgment.

"The annual rates of compensation for positions in this grade shall be $2,600, $2,700, $2,800, $2,900, $3,000, $3,100, and $3,200.

"Grade 3 in this service, which may be referred to as the associate professional grade, shall include all classes of positions the duties of which are to perform, individually or with a small number of trained assistants, under general supervision but with considerable latitude for the exercise of independent judgment, responsible work requiring extended professional, scientific, or technical training and considerable previous experience.

"The annual rates of compensation for positions in this grade shall be $3,200, $3,300, $3,400, $3,500, $3,600, $3,700, and $3,800.

"Grade 4 in this service, which may be referred to as the full professional grade, shall include all classes of positions the duties of which are to perform, under general supervision, difficult and responsible work requiring considerable professional, scientific, or technical training and experience, and the exercise of independent judgment.

"The annual rates of compensation for positions in this grade shall be $3,800, $4,000, $4,200, $4,400, and $4,600.

"Grade 5 in this service, which may be referred to as the senior professional grade, shall include all classes of positions the duties of which are to perform, under general administrative supervision, important specialized work requiring extended professional, scientific, or technical training and experience, the exercise of independent judgment, and the assumption of responsibility for results, or for the administration of a small scientific or technical organization.

"The annual rates of compensation for positions in this grade shall be $4,600, $4,800, $5,000, $5,200, and $5,400, unless a higher rate is specifically authorized by law.

"Grade 6 in this service, which may be referred to as the principal professional grade, shall include all classes of positions the duties of which are to act as assistant head of a major professional or scientific organization, or to act as administrative head of a major subdivision of such an organization, or to act as head of a small pro-

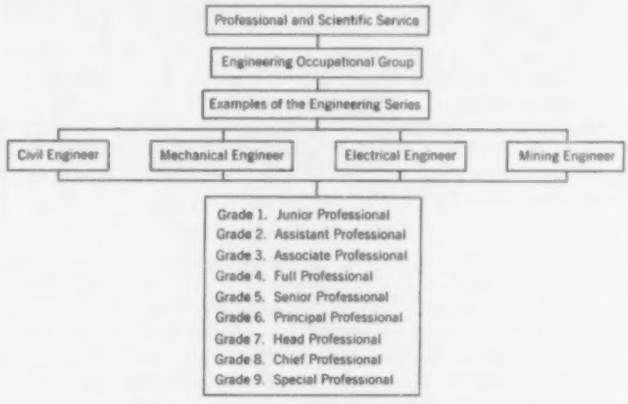

FIG. 1. APPLICATION OF FEDERAL CLASSIFICATION TO FOUNDER SOCIETY GROUPS

fessional or scientific organization, or to serve as consulting specialist, or independently to plan, organize, and conduct investigations in original research or development work in a professional, scientific, or technical field.

"The annual rates of compensation for positions in this grade shall be $5,600, $5,800, $6,000, $6,200, and $6,400, unless a higher rate is specifically authorized by law.

"Grade 7 in this service, which may be referred to as the head

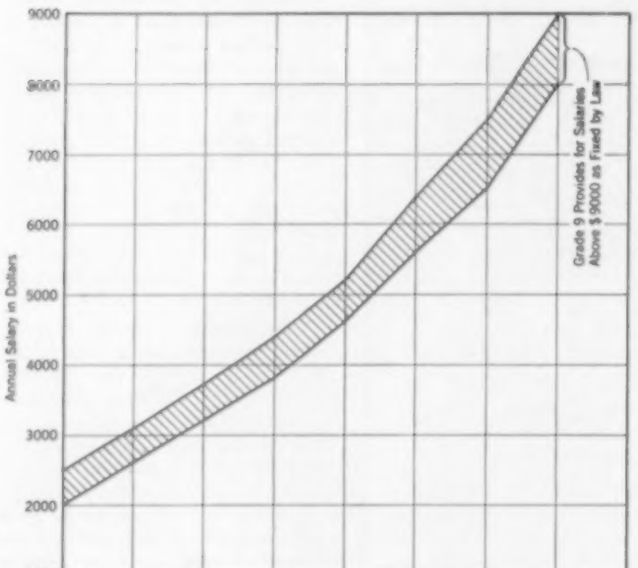

FIG. 2. SALARY RANGES IN THE PROFESSIONAL AND SCIENTIFIC SERVICE OF THE FEDERAL GOVERNMENT

professional grade, shall include all classes of positions the duties of which are to act as assistant head of one of the largest and most important professional or scientific bureaus, or to act as the scientific and administrative head of a major professional or scientific bureau, or to act as professional consultant to a department head or a commission or board dealing with professional, scientific, or technical problems, or to perform professional or scientific work of equal importance, difficulty, and responsibility.

"The annual rates of compensation for positions in this grade shall be $6,500, $7,000, and $7,500, unless a higher rate is specifically authorized by law.

"Grade 8 in this service, which may be referred to as the chief professional grade, shall include all classes of positions the duties of which are to act as the administrative head of one of the largest and most important professional or scientific bureaus, or to perform professional or scientific work of equal importance, difficulty, and responsibility.

"The annual rate of compensation for positions in this grade shall be $8,000, $8,500, and $9,000, unless a higher rate is specifically authorized by law.

"Grade 9 in this service, which may be referred to as the special professional grade, shall include all positions which are or may be specifically authorized or appropriated for at annual rates of compensation in excess of $9,000.

"SUBPROFESSIONAL SERVICE

"The subprofessional service shall include all classes of positions the duties of which are to perform work which is incident, subordinate, or preparatory to the work required of employees holding positions in the professional and scientific service, and which requires or involves professional, scientific, or technical training of any degree inferior to that represented by graduation from a college or university of recognized standing.

"Grade 1 in this service, which may be referred to as the minor subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate supervision, the simplest routine work in a professional, scientific, or technical organization.

"The annual rates of compensation for positions in this grade shall be $1,020, $1,080, $1,140, $1,200, $1,260, $1,320, and $1,380.

"Grade 2 in this service, which may be referred to as the under-subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate supervision, assigned subordinate work of a professional, scientific, or technical character, requiring limited training or experience, but not the exercise of independent judgment.

"The annual rates of compensation for positions in this grade shall be $1,260, $1,320, $1,380, $1,440, $1,500, $1,560, and $1,620.

"Grade 3 in this service, which may be referred to as the junior subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate supervision, subordinate work of a professional, scientific, or technical character, requiring considerable training or experience, but not the exercise of independent judgment.

"The annual rates of compensation for positions in this grade shall be $1,440, $1,500, $1,560, $1,620, $1,680, $1,740, and $1,800.

"Grade 4 in this service, which may be referred to as the assistant subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate supervision, subordinate work of a professional, scientific, or technical character, requiring considerable training or experience, and, to a limited extent, the exercise of independent judgment.

"The annual rates of compensation for positions in this grade shall be $1,620, $1,680, $1,740, $1,800, $1,860, $1,920, and $1,980.

"Grade 5 in this service, which may be referred to as the main subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate or general supervision, subordinate work of a professional, scientific, or technical character, requiring a thorough knowledge of a limited field of professional, scientific, or technical work, and the exercise of independent judgment, or to supervise the work of a small number of employees performing duties of an inferior grade in the subprofessional service.

"The annual rates of compensation for positions in this grade shall be $1,800, $1,860, $1,920, $1,980, $2,040, $2,100, and $2,160.

"Grade 6 in this service, which may be referred to as the senior subprofessional grade, shall include all classes of positions the duties of which are to perform, under immediate or general supervision, subordinate but difficult and responsible work of a professional, scientific, or technical character, requiring a thorough knowledge of a limited field of professional, scientific, or technical work, and the exercise of independent judgment, or to supervise the work of a small number of employees holding positions in grade 5 of this service.

"The annual rates of compensation for positions in this grade shall be $2,000, $2,100, $2,200, $2,300, $2,400, $2,500, and $2,600.

"Grade 7 in this service, which may be referred to as the principal subprofessional grade, shall include all classes of positions the duties of which are to perform, under general supervision, subordinate but responsible work of a professional, scientific, or technical character, requiring a working knowledge of the principles of the profession, art, or science involved, and the exercise of independent judgment, or to supervise the work of a small number of employees holding positions in grade 6 of this service.

"The annual rates of compensation for positions in this grade shall be $2,300, $2,400, $2,500, $2,600, $2,700, $2,800, and $2,900.

"Grade 8 in this service, which may be referred to as the chief subprofessional grade, shall include all classes of positions the duties of which are to perform, under general supervision, subordinate but difficult and responsible work of a professional, scientific, or technical character, requiring a thorough working knowledge of the principles of the profession, art, or science involved, and the exercise of independent judgment, or to supervise the work of a small number of employees holding positions in grade 7 of this service.

"The annual rates of compensation for positions in this grade shall be $2,600, $2,700, $2,800, $2,900, $3,000, $3,100, and $3,200."

CLASSIFYING 164,000 FEDERAL JOBS

The original Federal Classification Act was drafted after extensive studies of the employment and living conditions that had existed for a considerable number of years. All sections of the country were considered. These studies have been continued from time to time by

the agencies that have administered the act, and both the act and the administrative procedure have been modified as conditions demanded. Its administration is now under the Division of Personnel Classification of the U. S. Civil Service Commission. The act has been in operation for over ten years and has given general satisfaction both to the employees and to the employing agencies. Its provisions are now directly or indirectly applied to over 164,000 federal positions, a number about equal to the total number of engineers in the United States.

As already indicated, in the federal classification engineering positions fall in the professional and scientific service. They make up one of 12 occupational groups and are further divided into various series. Nine grades are provided for the various classes of positions in this service. Positions in the upper grades in the main have to do with administration or highly specialized work. In the positions in the lower grades administration generally plays a smaller part, and the work of the employee is done under direction or supervision, which increases in the lower grades. The occupants of positions in the upper grades, especially 7, 8, and 9, correspond to the executive or employer in non-governmental activities; those in the lower grades to the employee or technician, who may or may not have supervisory duties in connection with his work.

DIVIDED IN TERMS OF FOUNDER SOCIETIES

Four of the series in the engineering occupational group are designated by the names of the four Founder Engineering Societies, whose membership in fact represents the majority of all classes of engineering positions. The application of the federal classification to them gives the set-up in Fig. 1.

The principles and the technique of classification, as applied to engineering positions, are as fully applicable to similar positions in non-federal governmental agencies (state and municipal) and in non-governmental organizations (private and corporate) as they are to positions in the federal service. In fact, their advantages as tools in personnel administration are already recognized by many states and cities and by large private corporations, although the resulting classification systems differ in their details. The general application of the structure of the federal classification plan would provide a ready means for considering on a comparable basis most employment problems as affecting engineers in different jurisdictions and for making needed adjustments on a uniform basis.

Complete application of any classification of positions in the public service can, of course, be made only by governmental agencies. However, as the number of engineering positions in governmental agencies is not only increasing but already includes about a third of all civil engineering positions in the United States, the employment policies of governmental agencies will be a very persuasive factor in determining the employment policies of non-governmental agencies. It is highly desirable, from the standpoint of the employed engineer, that civil service and classification laws, according to a fairly uniform model, be applied to all governmental agencies, both federal and non-federal. General application of the principles of such laws will be in the public interest by insuring a high standard of service and will be in the employees' interests by fostering better working conditions, continuity of service, and stability of salary schedules.

PERCENTAGE VARIATIONS FROM BASE RATES

The bringing of engineering positions in all governmental agencies under uniformly patterned civil service and classification laws may tend eventually to bring similar positions in non-governmental agencies under a similar system.

The federal classification system, substantially an expansion of the system proposed by a committee of engineers many years ago, affords an effective and equitable basis for the establishment and maintenance of salary scales for positions covering all kinds of work. The salary schedules accompanying the classification, of which the ranges of values for engineers are shown in Fig. 2, have been the subject of much study and were set up as the reasonable wages under normal conditions, with the thought that adjustments for abnormal conditions should be made on a percentage basis instead of by changes in the base rates. Differences in living conditions in various sections of the country were not found sufficiently great to justify zoning, as adequate provision for such differences can be made by salary ranges within grades.

ADJUSTMENTS FOR LOCAL CONDITIONS MAY BE READILY INCLUDED

The accompanying Table I indicates the schedule of annual salary rates for the clerical, administrative, and fiscal service (CAF), custodial service (CU), professional and scientific service (P&S), and subprofessional service (SP), as applied in the federal government. The classification grades to which the salaries apply in the services are indicated in the last four columns.

The percentage basis for reducing salaries as a measure of economy during the depression was followed by many public and private agencies and applied to unclassified as well as to classified positions, either on a sliding scale or as a flat rate. By this method it is possible to adjust salaries affected by exceptional conditions without modifying the base of all salaries. For example, ready adjustment may be made for living conditions which are peculiar to one locality or for unusually difficult or unusually simple work within the general scope of the grade. Federal salary cuts during the depression ranged from 5 to 15 per cent and were applied with the expectation that they were to be restored as soon as conditions reached the established normal, and this was done. Had the reductions been made by changing the base salary it would have been much more difficult to obtain their restoration.

DESIRABILITY OF STANDARDIZING ON PROPER CLASSIFICATION

In general, salaries paid by federal agencies as compared with those paid by non-federal agencies, both private and governmental, are higher in the lower grades and lower in the higher grades. Economic changes are usually reflected much less in salaries of governmental positions, especially federal, than in non-governmental positions.

Civil service, classification, and salary schedules are distinct but closely related subjects. An adequate classification is essential to the satisfactory operation of civil service laws, and it is also basic in the selection of suitable personnel for various positions and in the fixing of an equitable compensation for their services. It provides a logical and effective means for the proper classification of positions, both within organizations and between organizations, which is essential for the equitable consideration of all questions having to do with employment. These three subjects are coming to be of more and more importance in determining the economic standing of the engineer, and it is highly desirable that they be standardized and that all engineers become fully informed in regard to them.

Various Division Committees Report

Abstracts from Presentations at the Society's Annual Meeting, January 15 and 16, 1936

Committee on Mutations and Blighted Areas in Cities Makes Progress Report

The purpose of the Committee on Mutations and Blighted Areas in Cities, of the City Planning Division, is to formulate a plan for research into the causes and effects of urban mutations and blighted areas. Its membership comprises Howard W. Green, chairman; and M. J. Evinger, George H. Herrold, Harold M. Lewis, and H. Shifrin. The committee has used this first year to consider its responsibilities. Of necessity committee business has been carried on by mail owing to the fact that its membership is widely scattered.

Probably in no period of the history of the United States have so many basic data been accumulated bearing directly or indirectly upon the problems with which this committee has to deal than during this New Deal era. The Division of Housing of PWA has inspired local groups all over the country to delve into the conditions of blighted areas which have become slums.

The chairman of this committee, through serving as consultant to the Division of Housing for five years in compiling and analyzing Cleveland data to the extent that one-tenth of the Division's funds have been allocated to Cleveland, and serving other communities as consultant, has collected a great deal of data pertinent to the subject.

The Real Property Inventory, created in Cleveland as a result of the National Conference of Construction in 1931, and developed into the Bureau of Foreign and Domestic Commerce Real Property Inventory in 64 cities, the CWA's real property inventory in one hundred or so additional cities, and the Federal Housing Administration's real property inventories still being carried out, have provided more basic data regarding use and condition of real property than any single activity of earlier origin.

The creation of census tracts as small, constant, statistical areas in New York City in 1906 by Walter Laidlaw, their value to business as demonstrated in Cleveland, and their application to over 47 of the largest cities in the United States through the efforts of the Committee on Census Enumeration Areas of the American Statistical Association, of which the chairman of this committee is also chairman, provides a means of localizing data collected by all of these new techniques.

The special studies of the Federal Housing Administration, their block analyses and their official recognition of such factors as stability of neighborhoods, conformity of dwellings as to type, usefulness, function, physical condition, architecture, etc., inspire broader recognition of the importance of other factors in evaluating property than mere reproduction cost or income possibilities.

If the committee had done nothing but review these recent contributions to knowledge, enumerate the type of facts made available, and evaluate their significance, its work would be enormous and its report voluminous.

If the committee evaluated the data, applied the findings, and attempted to diagnose the causal agents, years of study would be involved.

It is the opinion of the committee that, since more data are available on each of the 321 census tracts in the Cleveland Metropolitan District than is available in any other city in the United States, the chairman be encouraged to utilize these data in a preliminary study of one small section of the Cleveland Metropolitan District in order that a mode of procedure in studying the problems of mutations and blighted areas may be worked out in a small way, to be applied later to a more extensive study in Cleveland and in other cities in this country.

Committee on Equitable Zoning of Assessments for City Planning Projects

The report of the Committee on Equitable Zoning of Assessments for City Planning Projects, which was submitted by Frederic Bass, chairman, was published in full in the February 1936 issue of Proceedings. The other members of this committee of the City Planning Division are Philip H. Cornick, H. Shifrin, and H. H. Smith.

Committee on Construction Engineering Education

Probably the most important incident in the activities of the Committee on Construction Engineering Education of the Construction Division during the past year was its combination with a similar committee of the Society for the Promotion of Engineering Education to form a Joint Committee on Construction Engineering Education. The personnel of the joint committee is as follows: W. C. Huntington, chairman; M. I. Evinger, H. P. Hammond, C. J. Tilden, R. W. Abbett, L. E. Conrad, R. G. Paustian, W. C. Voss, and E. L. Grant.

Professor Stubbs has done an excellent job in studying the engineering and architectural curricula in colleges throughout the country to determine the extent to which courses in construction are now included. An abstract of his report is appended hereto. A study of his report indicates that this subject is being given much more consideration than most of us thought to be the case. Appended to Professor Stubbs' report but not included here is a partial bibliography of references on the subject of construction engineering.

Each member of the committee is giving special consideration to a definite phase of construction engineering education and will prepare a report on this phase for the consideration of the whole committee. These reports are being prepared from the point of view of policies, procedures, and outlines, and are not intended to present material for purposes of instruction. The subjects being considered at present are: Organization and management of construction operations; cost accounting, construction economics and financing; construction education as a part of regular courses or in separate courses; basic factors in construction engineering training; economic principles as applied to engineering construction; and the special curriculum in construction engineering.

Some of these subjects were decided upon last summer, but the arrangements have been completed just recently, so no report can be made on this work at present.

It is expected, however, that the various reports will be completed about May 15, 1936.

Some space in the February issue of the Journal of the Society for the Promotion of Engineering Education is to be devoted to the work of this committee. In this way, as well as by the presentation of papers at the Annual Meetings of the S.P.E.E. (as was done at their Atlanta meeting), the subject of construction engineering is being kept before the members of that society.

Abstract of the Report on the Study of Engineering Curriculums in Regard to Construction Engineering Education, by F. W. Stubbs

During the spring of 1934 the curriculums of 120 engineering schools were studied. Outlines were prepared of all courses that could be considered as related to the construction field, including contracts and specifications, business law, engineering law, professional relations, office practice, engineering economics, valuation, business organization and management, engineering administration, industrial safety, general economics, accounting, contracting methods, estimating, construction plant design, estimates and costs, construction methods and equipment, accident prevention, and cost keeping.

These outlines were sent to the respective schools with a request for such changes as might be required to bring the information up to date. By June 1935 some 90 schools had replied and their corrections were noted. Course data were received from 12 schools that were not on the original list, so the outlines now give data on 132 schools.

The schools offering courses in construction are Alabama Polytechnic Institute, University of Alberta, University of Arkansas, Armour Institute of Technology, Polytechnic Institute of Brooklyn, Carnegie Institute of Technology, University of Cincinnati, Clemson Agricultural College, University of Colorado, Columbia University, Cornell University, University of Delaware, University of Detroit, Drexel Institute, University of Florida, University of Idaho, University of Illinois, Iowa State College, Kansas State College of Agricultural and Applied Science, Lehigh University, Massachusetts Institute of Technology, University of Michigan, University of Minnesota, University of Missouri, University of Missouri (School of Mines and Metallurgy), University of Nebraska, North Carolina State College of Agriculture and Engineering, North Dakota Agricultural College, Oklahoma Agricultural and Mechanical College, University of Oklahoma, Oregon State Agricultural College, Pennsylvania State College, University of Puerto Rico, Rensselaer Polytechnic Institute, University of Southern California, South Dakota State College, Texas Technological College, Union College, Utah State Agricultural College, University of Utah, Virginia Polytechnic Institute, Washington State College, Washington University (St. Louis), and Yale University.

These 44 schools offer one or more courses relating particularly to the construction field, but there is a lack of uniformity in course titles and in content. The most common course is engineering estimates; however, it is not always clear whether this work is given from the point of view of the contractor or the engineer. A few schools study the problem of construction plant and equipment. Others cover varied problems peculiar to contracting, such as bonds, insurance, overhead costs, construction cost keeping, liens and lien laws, trade unions, construction equipment, accident prevention, job organization and management, qualification of bidders, forms of contracts, and catalogue studies of equipment.

Most of the schools include discussion of construction features in various courses on design, but the amount and character of construction work covered is difficult to determine. A course in contracts and specifications is offered by 60 schools and is usually given by the civil engineering department. Forty-one schools offer business or engineering law and a few give this in addition to contracts and specifications. Office practice is offered by the department of architecture in 9 schools. Professional relations is covered in a separate course in 20 schools and in most cases is offered by the department of architecture. Engineering economics and/or valuation are offered by 41 schools. Courses in engineering administration, and business organization or safety, are also given. Some schools use inspection trips to projects to emphasize the construction features.

COMMITTEE ON VALUATION PROCEDURE AND DEPRECIATION RENDERS PROGRESS REPORT

ALTHOUGH the Committee on Valuation Procedure and Depreciation of the Engineering-Economics and Finance Division was organized in 1932, unavoidable reasons prevented its meeting before late in 1934. The committee has been organized in five subcommittees, respectively on public utilities, private industrial properties, depreciation, valuation nomenclature, and manual of valuation and depreciation. The objective of our work is a final report comparable to the Society's classic 1917 public utilities valuation report, broadened to include the recent widespread extension of valuation into the many fields of private industry. Since 1934, the committee's immediate objective has been the preparation of a "Manual of Valuation Procedure and Valuation," to be completed during the summer or fall of 1936.

Work on the manual has been prosecuted actively throughout 1935. The purposes of the manual are twofold. For valuation engineers, the purpose is to outline succinctly the present greatly expanded field and much increased importance of valuation, and to state succinctly the essential features of the best up-to-date engineering valuation practice. For courts, commissions, government officials, owners, corporation officials, legal advisers, financiers, investors, and other users of engineering valuations, the purpose is to supply a concise, understandable statement of up-to-date good valuation practice. It is not the purpose of the manual to provide either a "standard" for engineers or a "rule-of-thumb" handbook for non-engineers. The manual is planned to consist of about 100 to 125 printed pages of standard size. The first draft of the manuscript includes the following subdivisions: (1) Introductory; (2) General Principles of Value and Valuation; (3) Valuation Procedure; (4) Valuations of Different Classes of Property; (5) Depreciation; (6) The Use of Mortality Curves in Estimating Probable Lives of Property Units; (7) Depreciation Accountancy; (8) Appendices—Glossary and List of Court Valuation Decisions Frequently Cited.

The members of the committee are Anson Marston, chairman; Henry K. Dougan, K. Lee Hyder, Frederick H. McDonald, W. D. Pence, W. L. Prouty, James T. Ryan, Ezra B. Whitman, and Edwin F. Wendt.

COMMITTEE ON PRACTICAL APPLICATION OF MODERN STRESS THEORIES AND FATIGUE RESEARCH

THE COMMITTEE on Practical Application of Modern Stress Theories and Fatigue Research is a technical committee of the Structural Division and was appointed on August 2, 1935, by Jonathan Jones, chairman of the Ex-

ecutive Committee of the Society, consisting of A. V. Karpov, chairman, and Hardy Cross, H. J. Gilkey, and C. M. Spofford. Although the committee was appointed in connection with the Structural Division symposium, "Structural Application of Steel and Light-Weight Alloys," that will be held in Pittsburgh in October 1936, Jonathan Jones, in his letter of August 2, 1935, stated: "The committee is not, however, a temporary one for the latter purpose. It is of great importance that the Structural Division have such a committee permanently organized to inform it of the new developments in the field indicated by its title."

The framed structures of the first quarter of our century were almost without exception constructed of open-hearth steels of virtually a single simple class. A few monumental structures turned to nickel or manganese or silicon for help, but these exceptional incidents made no impression upon average, or even upon fairly impressive, bridge spans, and meant literally nothing to thousands of structural designers.

It would seem today that a reappraisal of structural theory and of structural materials may be timely. New structural steels and light structural alloys are being pressed upon the structural engineer, not always perhaps with a very clear understanding of what he needs.

Future engineering progress depends very largely upon the changed engineering attitude as to the materials to be used in engineering designs. Instead of simply utilizing the existing easily obtainable materials, new materials are developed, which are not so easily obtainable and consequently are more expensive, but for one or a number of reasons are preferable or may be even more economical notwithstanding their higher cost.

Owing to the experimental and theoretical investigation made during the last few decades and prompted mostly by the needs of automobile and airplane designers, engineering science has undergone a considerable change, not unlike the recent spectacular changes in the physical and chemical sciences. These changes are influencing profoundly present mechanical designs, but in so far as the structural designs are concerned, there are diverging views concerning the necessity of changes in the design conceptions and practice. Possibly the best method to clarify the situation would be to state the two extreme viewpoints in this matter.

The traditional view is based upon past experience. The methods of design and safety factors used in the past resulted in safe designs. The stress concentration and fatigue phenomena are of importance in moving machinery in particular, in which rapid changes of stress occur. In structural designs complete reversal of stress occurs very seldom and the introduction of more complicated design theories is not justified.

The extreme view may be expressed as follows:

1. The customary methods of stress determination result in evaluated stresses, which under certain conditions may differ very considerably from the actual stresses.

2. The properties of materials, and in particular the different metals and alloys, cannot be properly characterized by a few coefficients such as the modulus of elasticity, ultimate stress, elongation, and elastic limit.

3. Although, in so far as can be foreseen at present, the open-hearth, ordinary grades of structural steel will form the main bulk of structural materials, nevertheless the special structural steels may increase in application and certain special fields may be occupied by light-weight alloys.

4. The uncertainty of the evaluated stresses and the insufficient knowledge of materials were, in the past, counterbalanced by the large experience gained during the last century and incorporated in many rules and customary practices.

5. The advance in structural designs necessitates a uniform and definite safety factor as contrasted with the customary apparent and uncertain safety factor.

6. The present situation in engineering designs is such that the conventional design theories do not give any methods for determining the exact stress, but in the best cases the average stresses can be determined.

7. The conventional designs neglect stress concentrations, fatigue, and creep phenomena. Such designs are idealized, presuming a mode of load application and jointing which in the majority of cases may not be approached, and the use of non-existing materials.

The problems involved are research problems and as such cannot be exactly defined. As a result, there is an enormous amount of work done out of which only a comparatively small part can be directly used. At present there is no organization in the structural field which would sift all the data already available and continually made available by the extended theoretical and experimental work.

The purpose of the committee is to bring together the information and data available and to study them, keeping in mind the particular needs of structural designing engineers. Such study should assist in judging of the value of the limiting views stated above and in determining what compromises between them best suit the needs of different structural designs. To what extent shall we revise our fundamental ideas in preparing new designs and in determining the safety of existing, but overloaded, designs? At present, the work of the committee is limited to metals and their application in structural designs.

COMMITTEE ON PRINCIPLES TO CONTROL GOVERNMENTAL EXPENDITURES FOR PUBLIC WORKS

THE REPORT of the Committee on Principles to Control Governmental Expenditures for Public Works was published in full in the February 1936 issue of PROCEEDINGS. The members of the committee are Charles Keller, chairman, W. W. De Berard, Fred Lavis, and L. C. Sabin.

SUBCOMMITTEE ON STRUCTURAL ALLOY AND HEAT-TREATED STEELS

THE REPORT of the Subcommittee on Structural Alloy and Heat-Treated Steels, of the Structural Division's Committee on Steel, submitted by Robert S. Johnston, chairman, will be published in the March 1936 issue of PROCEEDINGS. The other members of the subcommittee are A. W. Carpenter, R. J. Fogg, F. H. Frankland, S. Hardesty, Jonathan Jones, P. G. Lang, Jr., L. S. Moisseiff, H. W. Troelsch, A. R. Wilson, and W. M. Wilson.

SUBCOMMITTEE ON WIND BRACING IN STEEL BUILDINGS

THE REPORT of the Subcommittee on Wind Bracing in Steel Buildings, of the Structural Division's Committee on Steel, submitted by C. R. Young, chairman, will be published in the March 1936 issue of PROCEEDINGS. The other members of the subcommittee are Clyde T. Morris, N. A. Richards, and F. P. Witmer.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Graphical Solution of Certain Statically Determinate Structures

By BENJAMIN FORSYTH, JUN. AM. SOC. C.E.
WITH THE CARTOGRAPHIC STUDY, NEW YORK UNIVERSITY

I WISH to present here a mathematically correct method for the graphical analysis of certain statically determinate structures. The method is applicable only in those cases where the interior members such as 4-5 and 5-6, Fig. 1, may be removed without destroying the equilibrium of the joint at which they meet (joint 6). In other words, members 4-7 and 6-7 must lie on the same straight line. Some such cases to which it is applicable are the Fink truss, the Baltimore truss with subverticals, the fully subdivided Pettit truss with subverticals, the fan truss, the double fan truss, and the French truss. The method is exceedingly simple and has a distinct advantage over the standard "dummy member" method in the analysis of unsymmetrically loaded structures and of the fan truss. It makes possible a completely graphical, quick, and simple solution of the Baltimore and Pettit trusses with subverticals.

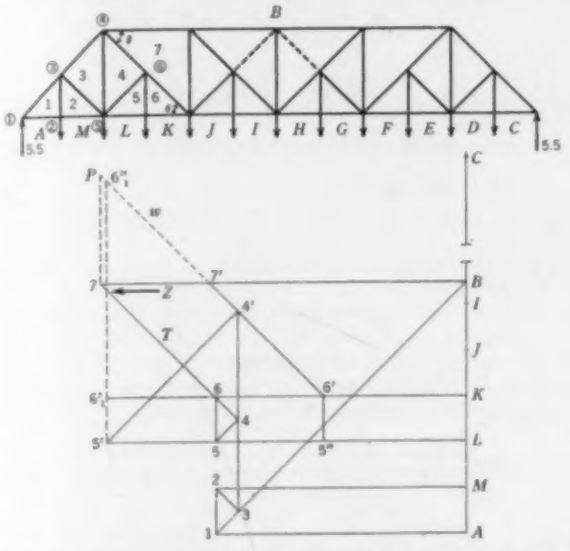

FIG. 1. DETERMINING GRAPHICALLY THE STRESSES IN A PANEL OF A BALTIMORE TRUSS

Let us consider the Baltimore truss shown in Fig. 1. The truss is drawn to scale and the members are designated according to Bow's notation. Proceeding to the stress diagram, we find that joints 1, 2, and 3 offer no difficulties. Joints 4 and 5, however, have three unknowns each. If we now assume a value for B-7, say B-7′, joint 4 has only two unknowns, and we can pass around it in the usual manner, obtaining point 4′. Without making any additional assumptions, we pass around joint 5 obtaining point 5′, and around joint 6, obtaining point 5″. The true position of point 5 is midway between points 5′ and 5″, and the true positions of points 4, 6, and 7 are immediately obtainable.

A complete solution of a Fink truss with unsymmetrical loading is shown in Fig. 2, and Fig. 3 shows the analysis of half of a double fan truss. In the latter case the difficulty of having three unknowns at two joints as we pass around the structure is met with twice in each half of the truss. The procedure is exactly the same, except that when the difficulty is encountered for the second time the true position of the unknown point is not midway between the two trial positions 19′ and 19″, but one-quarter the distance 19′-19″ away from 19′.

Proof of the correctness of the basic construction of Fig. 1 is given in the following paragraphs.

Let X = error introduced in B-7 by assuming an arbitrary position for point 7.

Then $X \sec\theta$ = corresponding error in 4-7, and
$X \sec\theta \sin\theta$ = corresponding error in 3-4.
Obviously, $X \sec\theta$ is also the error in 4-5, and X is also the error in L-5.

Now consider joint 6 in the truss diagram. The vertical components of the errors introduced in 4-7 and 4-5 balance each other. The horizontal components are additive and their sum is equal to $2X$. Hence, for horizontal equilibrium,

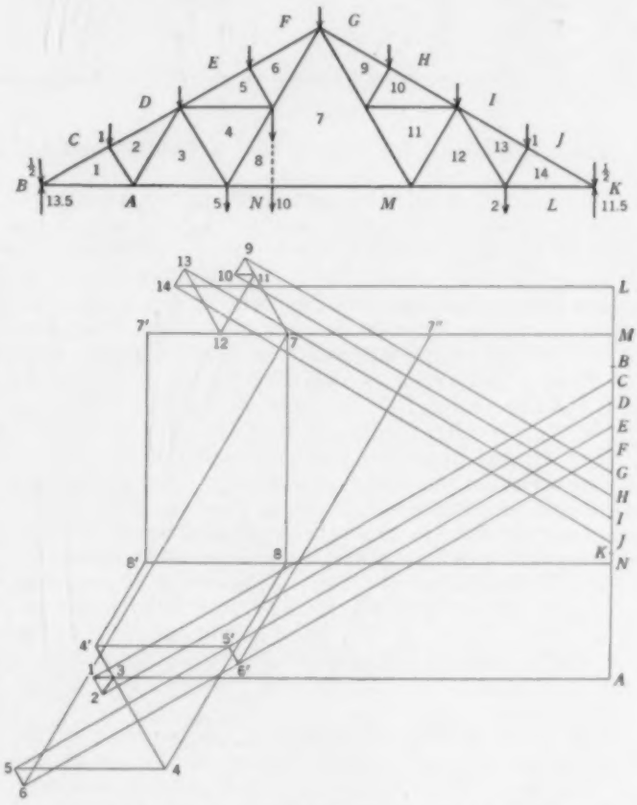

FIG. 2. COMPLETE GRAPHICAL SOLUTION OF A FINK TRUSS

$2X \sec\theta$ = error introduced in 6-7.

The vertical component of this error is $2X \sec\theta \sin\theta$ or $2X \tan\theta$. The total error introduced in 5-6 is obviously also $2X \tan\theta$.

Now in the stress diagram,

$B\text{-}7'$ = (true value of B-7) + X,

$3\text{-}4'$ = (true value of 3-4) + (error in 3-4 due to X),

and $5'\text{-}6''_1$ = (true value of 5-6) + (error in 5-6 due to X).

But since $5'\text{-}6'_1$ is the true value of 5-6, $6'_1\text{-}6''_1$ is the

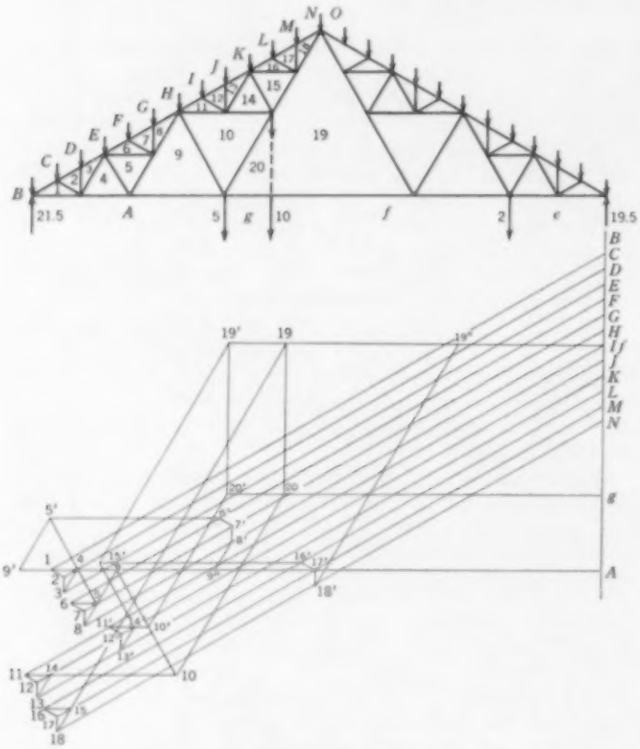

FIG. 3. GRAPHICAL SOLUTION OF LEFT HALF OF A DOUBLE FAN TRUSS

error in 5-6 due to X. Also $(Z\text{-}6'_1) = (Z\text{-}6''_1)$ = half the error in 5-6, or $X \tan\theta$.

Now the two parallel lines $7'$-w and Z-T, which by construction intercept half the error in 5-6, also intercept the whole error in B-7, for $(Z\text{-}6''_1) = X \tan\theta = (7'\text{-}p) = (7\text{-}7') \tan\theta$, whence $X = (7\text{-}7')$. Hence, since we have a method of determining the error in 5-6, we can find the error in B-7 and therefore the true position of point 7. All other points can then be easily located.

The general procedure outlined earlier in this article is based on the preceding analysis but does not require so much construction. Point $6'$ was located at the intersection of a line through $7'_1$ parallel to the member 6-7, and the indefinite line K-6; and point $5''$ was at the intersection of a line through $6'$, parallel to the member 5-6, and the indefinite line L-5. Hence by construction, $5''\text{-}5 = 6\text{-}6' = 7\text{-}7' = X$. But since $5'$-5, the error introduced in L-5, is also equal to X, it will be seen that $5\text{-}5''$ equals $5\text{-}5'$, and the exact position of 5 is halfway between $5'$ and $5''$.

The writer wishes to express his appreciation of the interest shown in the preparation of this article by J. Charles Rathbun, M. Am. Soc. C.E., and R. E. Goodwin and W. Allan, Associate Members, all of the School of Technology of the College of the City of New York.

Bending Moment in Beams with Hydraulic Loadings

By J. C. STEVENS, M. AM. SOC. C.E.

STEVENS AND KOON, CONSULTING ENGINEERS, PORTLAND, ORE.

IT is often necessary to design beams with a load that varies uniformly along part or all of its length. Some text- and handbooks give the characteristics of beams when fully loaded in this manner, but the writer has never seen fully set forth the case in which the loading covers only a portion of the beam's length.

Fig. 1(*a*) shows a freely supported beam of unit width with a partial hydraulic loading. The ratio of the loaded length of the beam to the total length, expressed decimally, is represented by z; w is the weight of a cubic foot of the loading liquid; and W is the total load, or $\frac{1}{2} wz^2l^2$. Taking moments at each support, and neglecting the weight of the beam, we find that

$$R_1 = \frac{wl^2}{6}(3z^2 - z^3) \quad [1]$$

$$R_2 = \frac{wl^2}{6} z^3 \quad [2]$$

The moment of the forces on the left of any section, x, is

$$M_x = \frac{W}{6}\{l^2 z^3 x - [x - l(1 - z)]^3\} \quad [3]$$

When the beam is fully loaded, $z = 1$, and we have

$$M_x = \frac{Wx}{3}\left(1 - \frac{x^2}{l^2}\right) \quad [4]$$

in which W = total load on beam = $\frac{1}{2}wl^2$.

Equation 4 is found in some text- and handbooks.

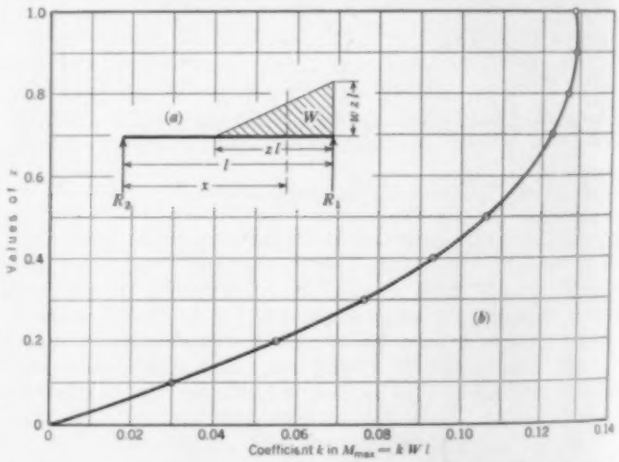

FIG. 1. COEFFICIENTS FOR DETERMINING MAXIMUM BENDING MOMENT IN BEAMS WITH PARTIAL HYDRAULIC LOADING

Equating the first derivative of Eq. 3 to zero, we find the maximum moment to be located at

$$x = l\left(1 - z + \frac{z^{3/2}}{\sqrt{3}}\right) \quad [5]$$

The value of this maximum is

$$M_{max} = \frac{wl^3}{6}\left(z^3 - z^4 + \frac{2}{3\sqrt{3}} z^{3/2}\right) \quad [6]$$

or, in terms of the total load W, which equals $\frac{1}{2}\, wz^2l^2$,

$$M_{max} = \frac{Wl}{3}\left(z - z^2 + \frac{2}{3\sqrt{3}}\, z^{3/2}\right). \quad . \quad . \quad . \quad [7]$$

When the beam is fully loaded, $z = 1$, and Eq. 7 reduces to

$$M_{max} = \frac{2\,Wl}{9\sqrt{3}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [8]$$

which will be found in a number of text- and handbooks.

Equation 7 may be written

$$M_{max} = k\,W\,l \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [9]$$

where the coefficient k has the value of $\frac{1}{3}\,(z - z^2 + \frac{2}{3\sqrt{3}}\, z^{3/2})$. The value of k for various values of z is given in Fig. 1(*b*). It will be noted that k has a maximum value at about $z = 0.94$, for which the moment is slightly greater than for the beam fully loaded.

A Helpful Rule for Use in Designing Retaining Walls

By D. B. HALL, ASSOC. M. AM. SOC. C.E.

ASSISTANT ENGINEER, STATE DEPARTMENT OF PUBLIC WORKS, ALBANY, N.Y.

USUALLY it will be found that the most economical base for a cantilever retaining wall is the one with the least permissible overall width. The problem of determining this width is complicated by that of determining the proper position of the base with respect to the wall. The following rule, however, furnishes a simple solution to the latter problem.

In Fig. 1, w is the unit weight of fill, W is the combined total weight of wall and fill on the footing, and A is the point behind which the resultant is required to fall. The rule is to place the wall so that W equals wha, or in other words so that the combined total weight of wall and fill on the footing equals the weight of a uniform fill extending up to point A.

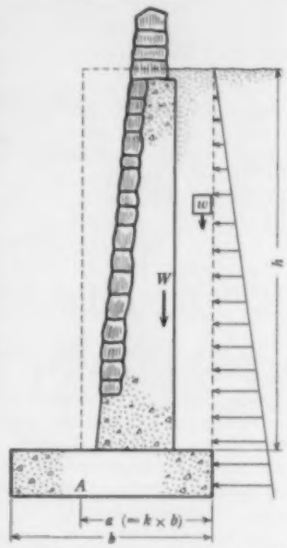

FIG. 1. DETERMINING THE PROPER POSITION OF A WALL WITH RESPECT TO ITS BASE

The proof of this rule is as follows. If the moment about A is clockwise the resultant is behind A; if the moment is counter-clockwise the resultant is in front of A. Therefore if the resultant can fall behind A at all, it will do so when the moment has its maximum clockwise value. If from any given position the wall is moved forward on the base an infinitesimal distance, dx, two changes in the moment are produced: (1) The moment of the load W, corresponding to the initial position of the wall, is decreased by Wdx; (2) an additional load, $whdx$, comes on the back of the footing, producing an additional moment, $whadx$. The maximum total clockwise moment about A occurs when the wall is in such a position that these two incremental moments are equal, that is, when $Wdx = whadx$ (or when $W = wha$).

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Highway Surveys

TO THE EDITOR: In his article, "Permanent Value for Highway Surveys Through Geodetic Control," in the December issue, J. C. Carpenter, M. Am. Soc. C.E., referred to a trial project now being developed by the Texas State Highway Department in Kenedy County. For some time, I have followed with interest the movement to consider the benefits to be derived from a sensible modification of the usual survey method for highway location, so that coordination may be established between highway location surveys and the comprehensive system of accurate geodetic surveys that has been, and is being, accomplished by the U. S. Coast and Geodetic Survey.

Early in 1934, I was assigned to make the location for Texas State Highway No. 96 through Kenedy County. As mentioned by Mr. Carpenter, this location is within the area covered by the primary triangulation along the ninety-eighth meridian arc. It was made by using the general standard practice for such surveys, but ties were made to as many of the primary triangulation stations as were easily accessible. This survey was made prior to the decision to inaugurate a trial project to ascertain the value of a higher type of highway survey, geodetically controlled. Later the trial project was authorized, and T. W. Bailey, M. Am. Soc. C.E., division engineer of the State Highway Commission, and I were ordered to carry the work on farther and to submit a report and recommendation for future surveys.

At this time the results of the test project are not complete, and no report for a recommended procedure for future surveys has been made. The locality of a survey to be made will have a definite bearing on the procedure for placing it on control. Its accessibility to the primary network will affect its cost. It may be desirable to utilize a secondary system of triangulation in making ties. Placing the surveys on control must result from careful planning. Several key surveys could be tied in, in advantageous places, and gradually extended to existing or future surveys. In all, the procedure must be carefully planned to minimize the cost. I believe that it is a program that cannot be accomplished hurriedly, nor can all location surveys be placed directly on control at the time of their making. They can, however, be monumented and referenced, so that as the network of such surveys on the geodetic control is extended, the remaining work necessary to tie them in will be reduced in both time and cost.

It might be mentioned that, at the present time, no reliable method of estimating the additional cost of making the ties for a survey has been arrived at. No doubt the first cost, which must be absorbed in the survey, will be slightly higher, but considering all values derived, it will probably appear good economy. It will materially decrease the costs of resurveys, which will have to be

made as time and conditions demand. One of the permanent values that should be considered is the fact that land boundary surveys could use the highway control as a base for their adjustment and connections. This is a distinct economic value for the public. At the present time, it cannot be considered an argument for an additional expenditure of highway funds, but it appears that for a comparatively small cost a reasonable modification of the usual highway survey method will yield a high return in permanent value.

MASON JOHNSON, Assoc. M. Am. Soc. C.E.
Resident Engineer, Texas State Highway Department

Corpus Christi, Tex.
February 3, 1936

Immediate Need for Maps

TO THE EDITOR: The article entitled "Natural Gas Pipe Line Located by Aerial Maps," by N. R. McKay, in the December issue, presents in clear fashion several good reasons why the control surveys and topographic maps of the National Mapping Plan should be completed at once. Mr. McKay states that "although the photographs were matched with great care, they did get out of line a little . . . " and "the approximate scale of our maps was sometimes annoying. . . ."

If the control surveys necessary in connection with the ten-year mapping plan were available, it is evident that the photographic strips covering the pipe-line route could be fitted to the control points so as to be in correct geographic position and in proper alignment. The same control surveys, crossing the photographic strip at frequent intervals, would also furnish enough data so that reasonably exact picture scales for each section of the photographic strip could be computed.

If the base maps of the national mapping schedule, as proposed under the so-called ten-year plan, were completed, a vast amount of quite complete general information would be available for preliminary study of such projects. Because these maps show topography, section lines, forest cover, and much other information accurately to scale, a very satisfactory tentative pipe-line location can be made in the office. From the tentative location shown on these base maps, an option could be obtained on the properties across which right-of-way easements would be required. Even with the base maps available, however, new aerial photographs to a larger scale than the base maps should be secured. But the amount of new flying for such pictures could be considerably reduced, and consequently the flying part of the work could be completed in fewer flying days. Furthermore, with good base maps to serve for flights, the use of cloth panels, staked out on the ground to mark flight lines, would probably not be necessary.

GEORGE D. WHITMORE, Assoc. M. Am. Soc. C. E.
Chief, Surveys Section, Engineering Service Division, Tennessee Valley Authority

Knoxville, Tenn.
February 4, 1936

Need for Large-Scale Mapping

TO THE EDITOR: I should like to comment on the article on "Surveying and Mapping in the Tennessee Valley," by Ned H. Sayford, M. Am. Soc. C.E., in the December issue. Engineering planning is dependent to a great extent on good maps. The first step to be taken on a project is to provide for the making of maps if they are not already available.

Planimetric maps of the Tennessee Valley are being made in preference to topographic maps as they can be constructed more rapidly by photogrammetric processes. Photogrammetry is helpful to the engineer in many ways, but he usually fails to make the fullest use of it. Present graphic methods of map compilation demand that image displacements, due to differences of elevation, be eliminated. These displacements are a direct measure of the elevation of the ground surface and will enable a person, with appropriate stereoscopic apparatus, to draw the contour lines with great accuracy. Such use of aerial photographs would provide better maps than we have today, and this art should be advanced.

The unmapped state in which the Tennessee Valley Authority found the state of Tennessee applies in general to the entire United States. To avoid continuous repetition of the delays and losses resulting from lack of maps in this country, provision should be made to complete the map of the United States as outlined by the National Mapping Plan.

The map work in the Tennessee Valley has provided experience in the construction of planimetric maps under conditions similar to those that would exist under the proposed National Mapping Plan. As a result of this project, an experienced personnel has been trained and a method of operation devised that has proved very successful.

THOMAS P. PENDLETON, M. Am. Soc. C.E.
Assistant Section Chief, Chattanooga Office, U. S. Geological Survey

Chattanooga, Tenn.
January 30, 1936

Atlanta Sewage Treatment Experiments Solve Many Problems

TO THE EDITOR: As so many chemical-treatment sewage plants working under conditions seemingly similar to those at the Intrenchment Creek plant at Atlanta, Ga., described by M. T. Singleton, M. Am. Soc. C.E., and G. R. Frith in the December issue, were having such a variety of results, there seemed no way of knowing in advance of our tests just what additional installation would be needed. Certain reports had stated that sprinkling filters could be used, and others that they could not be used, the conflicting decisions depending, doubtless, on what trade wastes were present in the sewage at the time the samples were taken. In our studies, tests taken regularly showed that, at times, the sewage was actually so alkaline that sprinkling filter treatment was undesirable, but those times were so short that this excess alkalinity could be overcome with very little cost.

We hope to develop the carbon dioxide treatment to such an extent that it will be a real aid in the treatment of this sewage at all times. Here we have one of those combinations that seems too good to be true. We collect the gas from the digester and burn it to heat the water to keep the digester at the right temperature; then we pass the gases of combustion through the sewage. The carbon dioxide is absorbed, and the pH value is lowered to a point where treatment by chemicals is more effective and the sewage is better conditioned for treatment by the filters. This increase in efficiency reduces the required sprinkler area and consequently the cost of construction. If the pH value should be reduced too much for proper bacterial action, it is automatically raised when the sewage loses its excess carbon dioxide in the sprays.

The present plant was designed in 1910, and it has been many years since any laboratory work has been done. We knew that industrial plants constructed since the laboratory was abandoned had added new wastes, but we hoped to find some economical way to reduce the cost of construction by the use of chemicals. The plan of using a small amount of copperas cuts the cost considerably, and that amount seems to please the bacteria in the beds and they do their work better. We expect to arrange for bleeding the deleterious trades wastes into the sewer at such rate as not to be injurious. Fortunately for us, the industries are willing to do what they can to help out.

While the operation of the experimental plant has not by any means answered all our problems, it has proved conclusively that our sewage can be successfully handled by sprinkling filters and that reasonable doses of chemicals greatly improve the operation.

WILLIAM A. HANSELL, M. Am. Soc. C.E.
Assistant Chief of Construction and Engineer of Sewers

Atlanta, Ga.
January 31, 1936

Low-Cost Road Construction

TO THE EDITOR: I should like to comment on the article on "Low-Cost Road Construction in Tennessee," by Frank W. Webster, M. Am. Soc. C.E., in the December issue. There has been much economic waste in some of the southeastern states during the past few years because of the failure of highway authorities to construct and reconstruct the highways to standards commensurate with the varying traffic needs. It is a waste of public funds to build highways, and particularly the pavement thereof, of a type not required by either present or prospective traffic demands. Pavement types are properly matters for engineering determination and ought never to be selected in response to political pressure.

It is comforting to the engineer to know, from Mr. Webster's article, that engineering thought has controlled the recent reconstruction of Tennessee highways, and that a type of paving requiring the minimum expenditure of public funds has been developed for traffic varying from 250 to 1,000 vehicles per day.

The cost of providing a permanent way for highway vehicles includes a service on the sums expended for construction. This item of service excludes the more expensive pavements of concrete-slab construction, except for main traveled roads. By far the greater part of the state highway systems in the southeastern states is not main traveled roads in a true engineering sense, and the extensive construction of concrete-slab pavement for highways of minor importance is a luxury, as well as a definite burden on the people of these states. Where the concrete-slab pavement is selected for main traveled roads, other features of construction, such as reduction of grades, elimination of curvature, and elimination of railway grade crossings and of other highway intersections, ought to be adopted. All of this would entail large costs and increase enormously the service on that cost.

Mr. Webster determined that water-and traffic-bound macadam was unsuitable for some part of the system, and that a bituminous binder was necessary. The reason was not failure of the pavement to carry the vehicles, but the dust resulting from the passage of these vehicles. It is justifiable engineering to adopt a modification of the macadam and substitute binders that do not create dust for highways carrying 250 vehicles and over per day.

J. E. WILLOUGHBY, M. Am. Soc. C.E.
Chief Engineer, Atlantic Coast Line Railroad Company

Wilmington, N.C.
February 7, 1936

Factors in Highway Maintenance

DEAR SIR: Those who are responsible for the construction and maintenance of highways in the southeastern states should give careful consideration to the splendid paper by Frank W. Webster, M. Am. Soc. C.E., on "Low-Cost Road Construction in Tennessee," in the December issue of CIVIL ENGINEERING.

The cost given by Mr. Webster for grading and drainage is rather low for the average road in this area. The cost for base and bituminous surface is about a general average under normal conditions. All these estimates would have to be raised from 25 to 40 per cent under present conditions. His specifications are complete yet plain enough for anyone to understand.

That part of the specifications referring to base construction is probably most important, but it is often ignored. "The material will not make up or bond except during the winter, and two full winter seasons are usually required to bond 2,000 cu yd per mile." Under present conditions, where emergency relief funds are being used, often the entire base is laid, sprinkled, and rolled until it appears to be well bonded; then the surface is laid. Sad experience has taught us that these bases were compacted, not bonded.

Material in the base soon begins to flow, and the surface cracks. During the winter rains water seeps through the surface, and it fails. When this occurs, the people who use the roads say, "I knew that black top would not make a road; they have wasted our money."

Mr. Webster has given us a real economic specification for low-cost roads. Let us follow it to the letter. Then our low-cost roads won't have high-cost maintenance.

WOOLSEY FINNELL, M. Am. Soc. C.E.

Montgomery, Ala.
February 6, 1936

Local Control Surveys in New Jersey

TO THE EDITOR: I should like to comment on the article by J. A. C. Callan, M. Am. Soc. C.E., in the December issue. We are on the threshold of an era of coordinated surveys, geodetically controlled. Although the U. S. Coast and Geodetic Survey has been at work since 1807, providing the country with a splendid precise triangulation and level network, until the present it has been only with the greatest difficulty that this work could be used to control and coordinate the thousands of minor surveys continually being made throughout the country. Recently the U. S. Coast and Geodetic Survey has brought before the nation the possibility of establishing local control surveys, based on these precise nets, which will make geodetic control available to all.

I am confident that little can be added to Professor Callan's paper. However, it may be of interest to point out certain features of the local control survey in New Jersey, which are unique in that state. The geographic shape of New Jersey requires the transverse Mercator projection, as is the case in Alabama. This projection introduces a scale correction not greater than one part in 40,000 for all but a few square miles of the state, and the scale is exact in the two large metropolitan districts—one opposite New York City and the other opposite Philadelphia. Thus a very excellent arrangement results.

Recognizing the great advantages to be obtained from geodetic control for the permanent location of property boundaries, the state legislature last winter passed a law making the plane coordinate system, established by the U. S. Coast and Geodetic Survey, the survey base for New Jersey. It named this system the "New Jersey Plane Coordinate System," accredited all triangulation points and control points set with second-order accuracy as points marking precisely the position of this coordinate system, and made it possible to include the coordinates of the property corners and grid bearings in deed descriptions. The May issue of the *Geodetic Letter* describes this law in detail, and it is also described in the November 1935 issue of CIVIL ENGINEERING, pages 683 to 687.

Already an ordinance has been passed by the municipality of Tenafly, in Bergen County, requiring New Jersey plane coordinates to be shown in new real estate developments not more than a quarter of a mile from control points. The State Departments of Conservation and Development, and Institutions and Agencies, and the State Water Policy Commission had the U. S. Coast and Geodetic Survey place triangulation points in or near state-owned lands. And three triangulation points were set along a disputed county line in order to obtain the advantages of the legal survey base.

Forty-five magnetic stations in New Jersey have been reoccupied and observations taken, and many airports in the state have been provided with magnetic stations so arranged that airplane compasses can be adjusted with facility at these points.

There has been considerable interest in the use of control for mapping. Essex County is already beginning a map; Bergen and Middlesex counties are soon to follow. All of them use this control for their surveys.

There exist in New Jersey many third-order triangulation points, the plane coordinates of which have not been computed. In order to facilitate mapping as well as the use of third-order points with the minimum of computation, the local control survey has to date computed for over two-thirds of the area of the state the New Jersey plane coordinates of the minute intersection of latitude and longitude. By double straight-line interpolation it is possible to determine the coordinates of any geographic position to a maximum error of 0.05 ft north and south, and 0.03 ft east and west.

The United States Engineer Department has been engaged in a careful determination of the shore erosion at Absecon Inlet, just north of Atlantic City. The maps which this department is preparing for the project are based on geodetic control and New Jersey plane coordinates, and the table is being utilized to reduce computation.

PHILIP KISSAM, Assoc. M. Am. Soc. C.E.
Associate Professor of Civil Engineering, Princeton University

Princeton, N.J.
February 2, 1936

Malaria Control Is the Engineer's Concern

TO THE EDITOR: The article on "Malaria Control in the Tennessee Valley" by W. G. Stromquist, M. Am. Soc. C.E., in the December issue, brings to the attention of engineers a subject having vital bearing on many construction projects undertaken within the malaria belt, the Tennessee Valley from Chattanooga to the mouth of the river being a portion of this area.

The relation between construction in malarious regions and malaria is so well stated in the foreword to a brochure, entitled *Malaria Control for Engineering Students*, submitted by the Subcommittee on Engineering, National Malaria Committee, 1935, that it is quoted as follows, with slight changes:

"Often a large part of the malaria of any community may be man-made and is preventable, at a price. The responsibility of man-made malaria rests directly on construction works, and these are generally designed and supervised by engineers. The engineer is, therefore, either through neglect or ignorance, often responsible for the creation of more malaria or for its continuation, when by the application of the fundamental principles of malaria control it could be minimized or prevented."

Any construction project that creates an uncovered cavity in natural ground, in which water may be stored, or that involves construction which will raise the water level in an existing water course, should include in its design means to control mosquito breeding. The problem of malaria control may influence the choice of location of a construction camp and the cost of maintenance of protection, medical attention, hospitalization, compensation, and labor. Proper consideration of influencing factors may reduce or eliminate such costs.

In highway and railroad work the economics of construction is affected by culvert elevations and borrow pit location and drainage. But a highway causing malaria along its length, or being the means of importing the disease from one locality to another, while it may carry the traffic intended, does not attain its goal of social betterment.

Likewise, in canal construction the placing of spoil banks and other design and construction features may determine whether the project will or will not best serve its full purpose. Levee work to reclaim flooded land and tile drainage to render productive soil that is too moist may introduce malaria hazards which in ultimate cost will far outweigh advantages gained. Smaller impoundages, such as for water-supply lakes or for recreational purposes, should be constructed only after a thorough consideration of malarial possibilities and control.

In hydro-electric projects malaria is largely built in or built out by the designing and supervising engineer. Again quoting from the same publication of the National Malaria Committee: "It may be stated that there should be no conflict whatsoever between hydro-electric development and health conservation. Rather the two are workers together for the common good, water power promoting industrial and social progress and public health providing an atmosphere in which the enterprise can live and move."

Clearing operations as prescribed by our regulations are nothing more than an effort to shorten the time normally required by nature to perform this work and establish her equilibrium, thus eliminating the period during which natural conditions would favor the mass production of the *Anopheles quadrimaculatus*. The soundness of the practice has been demonstrated on many projects constructed within the state since 1920.

The operations of the Tennessee Valley Authority constitute the largest project developed within the state. The Tennessee River will be impounded from the east to the west border. Each of the pools presents different problems. As indicated, the solution of many of these is not known. From the construction of this project, however, there will come knowledge that will aid in handling future problems. Not only the public health engineer but the whole engineering profession is interested in the results.

G. H. HAZLEHURST
Chief Engineer and Director, Bureau of Sanitation, Alabama State Department of Public Health

Montgomery, Ala.
January 30, 1936

Factor of Obsolescence in Highway Surveys

TO THE EDITOR: The article on "Permanent Value for Highway Surveys Through Geodetic Control," by J. C. Carpenter, M. Am. Soc. C.E., in the December issue, discusses a timely subject, sufficiently important to challenge the attention and consideration of every highway engineer. Mr. Carpenter calls attention to the rather temporary nature and circumscribed utility of highway survey records resulting from present procedure. The reasons for survey obsolescence are as follows: (1) Very few industrial, commercial, transportation, or area surveys of minor proportions have been executed on rigid control, either horizontal or vertical—more especially horizontal; (2) common initial datum has not been generally employed so that the possibility of checking new work against old, or of correlating the work of one survey with that of an intersecting, or abutting, survey is not possible in many instances; (3) rigid specification for procedure and limits of error in execution as well as for the adjustment of figure and circuit is usually lacking; and (4) filing and cross reference of field and office records frequently have not been highly efficient, thus diminishing if not precluding their future usefulness.

Employment of the national geodetic control scheme and datum will remove the first two causes of the limited usefulness of present surveys. Conforming to the specification for surveys published by the U. S. Coast and Geodetic Survey or those published and distributed by the Surveying and Mapping Division of the Society will remove the third cause of obsolescence. If the fourth factor of survey obsolescence is not corrected, much of the value of correcting the first three factors will be lost. In other words, we may have executed a correct field survey, based on national geodetic datum, and used correct methods and precision in computations and adjustments, but if we do not catalog and file field and office records, or an abstract of them, so that they will be readily available for future reference, we have added only slightly to the life of the survey.

It would seem desirable and economically justifiable to establish a department of surveys, mapping, and records under the direction of the state highway engineer in each state. Much valuable information in the form of maps and survey records of national, state, county, and city organizations could be assembled and catalogued in such a department.

Efficient monumentation and readily available records are the perpetuating features of any survey; one without the other is of little value. Designation markings and location descriptions must be thoughtfully selected and executed in order to eliminate confusion of data as well as to facilitate future recovery.

Mr. Carpenter discloses the twofold value of employing geodetic control for highway surveys. The highway survey itself may be checked by tie-in on any control monument. If due regard has been given to monumentation en route and precision in execution has been exercised, the base control net has been expanded by as many miles as comprise the project.

The results of the trial project, as developed by the Texas State Highway Department, will be watched with interest. It must be remembered that pioneering is often tedious, discouraging, and expensive. No doubt it will take highway engineers as a group, considerable time to become "geodetic minded." We may not grasp at once the complete significance of surveys executed to common datum—their present worth, their future value, their potential value as a basis for property surveys, description, and record, their effect on precision and accuracy of performance within the profession.

Mr. Carpenter is to be commended for his concise but forceful presentation of this vital subject. I concur in his closing statement, "it becomes an obligation of the engineering profession to adapt the method of geodetic control for all surveys."

N. E. WOLFARD, M. Am. Soc. C.E.
Associate Professor of Civil Engineering, University of Oklahoma

Norman, Okla.
January 28, 1936

SOCIETY AFFAIRS

Official and Semi-Official

Meeting of Outgoing Board of Direction—Secretary's Abstract

ON JANUARY 13 and 14, 1936, the Board of Direction met at Society Headquarters with President Arthur S. Tuttle in the chair; and present, George T. Seabury, Secretary; Past-Presidents Hammond and Eddy; Vice-Presidents Dewell, Hogan, Riggs, and Sawyer; Directors Barbour, Burdick, Crawford, Ferebee, Horner, Leisen, McDonald, Morse, Noyes, Perry, Poole, Reed, Sanborn, Sherman, Stabler, Trout, Wilkerson; and Treasurer Hovey. The members of the incoming Board were also present by invitation.

Approval of Report and Minutes

Draft of the Annual Report of the Board was presented, revised in minor detail, and approved. The Board also approved the minutes of the Executive Committee meeting of December 16, 1935, approving its actions as the actions of the Board. Minutes of the Board meeting, October 14–15, 1935, were also approved.

J. Waldo Smith Fund

The committee on the disposition and use of the income of the J. Waldo Smith Fund reported its studies on a variety of objectives, recommending a Memorial Volume in popular style on the Catskill Water Supply Project. The Board approved this recommendation and the appointment of the following committee to carry it out: James F. Sanborn, chairman; John H. Cook, Carleton E. Davis, Alfred D. Flinn, George G. Honness, Thaddeus Merriman, Walter E. Spear, and Frank E. Winsor.

Resolutions of Buffalo Section re Lake Levels and Niagara Falls

From the Buffalo Section, two resolutions were read, as follows:

(1) "LAKE LEVELS

"WHEREAS, For forty years the federal government, and various municipal governments adjacent to the Great Lakes, have reported upon the necessity for, and the practicability of, construction to regulate the height of water in Lakes Michigan, Huron, and Erie; or for the construction necessary to compensate for the lowering of said lakes due to the diversion at Chicago and from other causes and

"WHEREAS, The reports of various boards and commissions have stated that regulation and/or compensation is practical,

"*Therefore* it is the recommendation of the Buffalo Section of the American Society of Civil Engineers that the federal government proceed at once with the construction of regulating and/or compensating works to maintain the levels in Lakes Michigan, Huron, and Erie. It is further recommended that copies of this recommendation be forwarded to the parent Society, the Sections of the Society along the said lakes and the United States senators and representatives of the said states."

(2) "NIAGARA FALLS

"Preservation of;

"WHEREAS, The Buffalo Section of the American Society of Civil Engineers having recommended the immediate construction of works for regulating and/or compensating for the lowering of the water levels of Lakes Michigan, Huron, and Erie, and

"WHEREAS, the preservation of the falls of the Niagara River is intimately connected to such regulation and/or compensation, and

"WHEREAS, the works necessary for the preservation of the falls of the Niagara River can be so constructed as to preserve the falls and at the same time permit the use of more water for power to both the United States and Canada; therefore

1935 BOARD OF DIRECTION OF THE SOCIETY

From the near Corner, Clockwise: Herman Stabler, Director, District 5; Frederick H. McDonald, Director, District 10; C. Arthur Poole, Director, District 3; John P. Hogan, Vice-President, Zone I; Harrison P. Eddy, Past-President; Henry D. Dewell, Vice-President, Zone IV; H. S. Morse, Director, District 9; Theodore A. Leisen, Director, District 16; D. H. Sawyer, Vice-President, Zone II; Henry J. Sherman, Director, District 4; Ralph J. Reed, Director, District 11; J. P. H. Perry, Director, District 1; W. W. Horner, Director, District 14; Henry E. Riggs, Vice-President, Zone III; F. A. Barbour, Director, District 2; James L. Ferebee, Director, District 7; Ivan C. Crawford, Director, District 12; James F. Sanborn, Director, District 1; E. N. Noyes, Director, District 15; Otis E. Hovey, Treasurer; Carolina Crook, Secretary to Mr. Seabury; George T. Seabury, Secretary; Arthur S. Tuttle, President, 1935; T. J. Wilkerson, Director, District 6; Charles B. Burdick, Director, District 8; Charles E. Trout, Director, District 1; and Alonzo J. Hammond, Past-President.

"*Resolved* that the Buffalo Section of the American Society of Civil Engineers recommends that works for the preservation of the falls of the Niagara River be at once undertaken; and be it further

"*Resolved* that copies of this resolution be forwarded to the parent Society, to Sections of the Society along the Great Lakes and to members of the United States Senate and Congress (House of Representatives) from states bordering upon the Great Lakes."

These resolutions were referred to a committee consisting of Harrison P. Eddy, Edward P. Lupfer, C. Arthur Poole, L. L. Hidinger, and James L. Ferebee, for an early report to the Board.

Conference on Soil Mechanics and Foundation Engineering

Authority was given the President to appoint Society delegates to the International Conference on Soil Mechanics and Foundation Engineering at Harvard University, June 22–26, 1936.

Society Local Sections

Amendment to the By-Laws of the San Diego Section was approved. Proposed revision in the constitution of the New Mexico Section was approved. The constitution of the new Kentucky Section of the Society, which held its organization meeting on December 17, 1935, was approved.

Federal System of Classifying Engineering Positions

A resolution was received from the District of Columbia Section urging adoption of the Federal system of classifying engineering positions for use in Society work and studies. The matter was referred to a special Board committee, composed of Herman Stabler, chairman, C. B. Burdick, and B. A. Etcheverry, for later report.

Waterway Clearances and Valuation

Two matters were presented from the Engineering-Economics and Finance Division with Board action as follows: (1) Recommendations relative to waterway clearances were adopted, as given elsewhere in full in this issue; (2) a member of the Board, Vice-President Riggs was added to the Division's Committee on Valuation.

Routine Reports

Regular reports were received from United Engineering Trustees, Engineering Foundation, American Engineering Council, and Construction League of the United States.

Reports of Board Committees

Action on reports of committees of the Board was taken as follows: Publications—report received and approved; Professional Conduct—three cases considered in detail and recommendations of the committee adopted; Districts and Zones—extensive recommendations of the committee were studied and referred to a committee of the new Board consisting of the President, two Past-Presidents, and four Vice-Presidents for report at a later meeting. Several committees whose work was of a temporary character or whose work was considered finished were discharged.

Student Chapters Recognized

Approval was given to the recommendation of the Committee on Student Chapters that "letters of commendation" be sent to selected Student Chapters, also a recognition for "conspicuous progress," as indicated elsewhere in this issue.

On recommendation of the committee, formation of a Student Chapter at the University of Maryland was approved.

Other Society Committees

A number of committees advisory to the Board reported progress. Other reports, including those of the Committees on Juniors, Local Sections, and Aims and Activities, were deferred for consideration at a later meeting. Report of the Committee on Registration of Engineers was received, adopting the recommendation that the committee be expanded to include, as corresponding members, the presidents of the Texas, Georgia, Nebraska, St. Louis, Maryland, Northeastern, District of Columbia, and Kentucky Local Sections.

Budget Approved

The Society budget as submitted by the Executive Committee was presented and discussed in detail. As revised it was approved for recommendation to the incoming Board.

Certificates to Retiring Members

A certificate of service on the Board of Direction was presented to each retiring member with appropriate remarks, as noted separately elsewhere in this issue.

Routine Matters

As is usual, a number of administrative and routine matters were presented and acted upon.

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Meeting of the Incoming Board of Direction—Secretary's Abstract

THE BOARD OF DIRECTION met at the Headquarters of the Society on January 16, 1936, with President Daniel W. Mead in the chair; and present George T. Seabury, Secretary; Past-Presidents Eddy and Tuttle; Vice-Presidents Riggs, Sawyer, Lupfer, and Dennis; Directors Arneson, Barbour, Burdick, Crawford, Ferebee, Finch, Hidinger, Hill, Leisen, McDonald, Morse, Myers, Poole, Proctor, Stabler, Trout, and Wilkerson; and Treasurer Hovey.

Greeting to New President

Congratulations to Dr. Mead on his election as President were received from the Engineering Society of Wisconsin.

Engineers as State Directors of PWA

Resolution was received from the Northwestern Section of the Society, requesting that the Board act to secure the continuance of engineers formerly State Engineers, PWA, in the new positions of State Directors, PWA. The question was referred to American Engineering Council with request that it use its influence and efforts towards that accomplishment.

Budget Adopted

The budget for the year 1936 as recommended by the outgoing Board was received, revised, and adopted.

Administrative Procedure

Various matters of Board routine and Society internal procedure were explained for the benefit of new members.

Committees Appointed

Upon recommendation of the President, the following committee personnel was approved:

EXECUTIVE COMMITTEE: Daniel W. Mead, Chairman; Arthur S. Tuttle, Vice-Chairman; Harrison P. Eddy, Henry E. Riggs, and Donald H. Sawyer.

COMMITTEE ON HONORARY MEMBERSHIP: Daniel W. Mead, Chairman; Harrison P. Eddy, Harry W. Dennis, Edward P. Lupfer, Henry E. Riggs, Donald H. Sawyer, and Arthur S. Tuttle.

COMMITTEE ON DISTRICTS AND ZONES: B. A. Etcheverry, Chairman; R. A. Hill, T. A. Leisen, Herman Stabler, and C. E. Trout.

COMMITTEE ON PROFESSIONAL CONDUCT: Henry E. Riggs, Chairman; Ivan C. Crawford, Harry W. Dennis, James L. Ferebee, L. L. Hidinger, and Carlton S. Proctor.

COMMITTEE ON PUBLICATIONS: F. A. Barbour, Chairman; Charles B. Burdick, James K. Finch, Edward P. Lupfer, and C. E. Myers.

COMMITTEE ON MEMBERSHIP QUALIFICATIONS: Frederick H. McDonald, Chairman; E. P. Arneson, Ivan C. Crawford, Harry W. Dennis, and C. Arthur Poole.

COMMITTEE ON REGIONAL MEETINGS:

Annual Meeting: Edward P. Lupfer, Chairman; O. H. Ammann, James K. Finch, Carlton S. Proctor, and C. E. Trout.

Southern Meeting: Donald H. Sawyer, Chairman; E. P. Arneson, L. L. Hidinger, Frederick H. McDonald, and Herman Stabler.

Annual Convention: Harry W. Dennis, Chairman; Ivan C. Crawford, B. A. Etcheverry, R. A. Hill, and T. A. Leisen.

Northern Meeting: Henry E. Riggs, Chairman; F. A. Barbour, Charles B. Burdick, James L. Ferebee, H. S. Morse, C. E. Myers, C. Arthur Poole, and T. J. Wilkerson.

COMMITTEE ON RESEARCH: Thorndike Saville, Chairman, term ending January 1937; Fred C. Scobey, term ending January 1938; Albert F. Reichmann, term ending January 1939; W. J. Mead, term ending January 1940; and Charles B. Burdick, Contact Member.

COMMITTEE ON LOCAL SECTIONS: V. H. Cochrane, Chairman, term ending January 1937; Andrew P. Rollins, term ending January 1938; E. B. Black, term ending January 1939; A. T. Dusenbury, term ending January 1940; and James L. Ferebee, Contact Member.

COMMITTEE ON JUNIORS: Charles M. Davis, Chairman, term ending January 1937; F. W. Green, term ending January 1938; Howard R. Green, term ending January 1939; N. T. Veatch, Jr., term ending January 1940; and T. A. Leisen, Contact Member.

COMMITTEE ON STUDENT CHAPTERS: R. L. McCormick, Chairman, term ending January 1937; H. W. Hanly, term ending January 1938; Glen E. Edgerton, term ending January 1939; R. B. Wiley, term ending January 1940; and T. J. Wilkerson, Contact Member.

COMMITTEE ON ENGINEERING EDUCATION: R. H. Ford, Chairman, term ending January 1937; Robert L. Sackett, term ending January 1938; Joseph W. Barker, term ending January 1939; Leslie F. Van Hagan, term ending January 1940; and Ivan C. Crawford, Contact Member.

COMMITTEE ON REGISTRATION OF ENGINEERS: James L. Ferebee, Chairman, term ending January 1938; Charles H. Paul, term ending January 1937; Joseph Jacobs, term ending January 1939; and C. E. Myers, Contact Member.

COMMITTEE ON FEES: Enoch R. Needles, Chairman, term ending January 1938; D. B. Steinman, term ending January 1937; J. Vipond Davies, term ending January 1939; Frank A. Marston, term ending January 1940; and Carlton S. Proctor, Contact Member.

COMMITTEE ON SALARIES (UNCHANGED): E. P. Goodrich, Chairman; A. B. McDaniel, Vice-Chairman; E. O. Griffenhagen, W. F. Reeves, Arthur Richards, and O. H. Ammann, Contact Member.

COMMITTEE ON PUBLIC EDUCATION: Theodore R. Kendall, Chairman, term ending January 1939; William H. Adams, term ending January 1940; James K. Finch, Director; H. S. Morse, Director; and C. E. Myers, Director.

COMMITTEE ON TECHNICAL PROCEDURE: Daniel W. Mead, Chairman; Edward P. Lupfer, Board Member; C. E. Trout, Board Member; Harold M. Lewis, Chairman, City Planning Division; A. E. Horst, Chairman, Construction Division; Julius Adler, Chairman, Highway Division; Frederick W. Doolittle, Chairman, Power Division; Edwin F. Wendt, Chairman, Engineering-Economics and Finance Division; Alfred Tamm, Chairman, Irrigation Division; H. Burdett Cleveland, Chairman, Sanitary Engineering Division; Jonathan Jones, Chairman, Structural Division; William Bowie, Chairman, Surveying and Mapping Division; W. G. Atwood, Chairman, Waterways Division; Thorndike Saville, Chairman, Committee on Research; F. A. Barbour, Chairman, Committee on Publications; and George T. Seabury, Secretary.

COMMITTEE ON PROFESSIONAL ACTIVITIES: Daniel W. Mead, Chairman; O. H. Ammann, Ivan C. Crawford, James L. Ferebee, James K. Finch, T. A. Leisen, H. S. Morse, C. E. Myers, Carlton S. Proctor, T. J. Wilkerson, and George T. Seabury, Secretary.

COMMITTEE ON ACCREDITED SCHOOLS: J. G. Bennett, Chairman, term ending January 1937; Franklin Thomas, term ending January 1938; John C. Riedel, term ending January 1939; W. C. Huntington, term ending January 1940; and B. A. Etcheverry, Contact Member.

COMMITTEE ON AIMS AND ACTIVITIES: J. P. H. Perry, Chairman, term ending January 1939; Frederick H. McDonald, term ending January 1937; R. C. Marshall, term ending January 1937; T. E. Stanton, Jr., term ending January 1937; Frank A. Barbour, term ending January 1938; Ernest O. Sweetser, term ending January 1938; S. F. Voorhees, term ending January 1938; George B. Gascoigne, term ending January 1939; and H. S. Morse, term ending January 1939.

Federal Control Over Streams

A resolution was adopted relating to the desirable limitation in Federal activities in control of streams, as noted in detail elsewhere in this issue.

Adjournment

The Board adjourned to meet in connection with the Hot Springs, Ark., Spring Meeting of the Society on April 20, 1936.

Secretary's Abstract of Executive Committee Meeting

ON JANUARY 16, 1936, the Executive Committee met at Society Headquarters with President Daniel W. Mead in the chair. Present were George T. Seabury, secretary; Otis E. Hovey, treasurer; and Messrs. Eddy, Riggs, Sawyer, and Tuttle.

Approval of Minutes

The minutes of the meeting of the Executive Committee held on December 16, 1935, were approved.

Vice-Chairman Appointed

Past-President Tuttle was appointed vice-chairman of the committee for the year 1936 and was given official authority to sign vouchers during the year.

Securities Owned by Society

Formal action was taken authorizing the disposition of a number of securities.

Appointments

At the request of the President, suggestions were received for suitable appointees as Society and committee representatives.

National Bureau of Engineering Registration Issues Bulletin

THE National Bureau of Engineering Registration has recently published a bulletin describing its purposes and methods of operation. The Bureau, says the bulletin, was established "primarily for the convenience of engineers, especially those practicing in more than one state, to minimize the effort and expense of securing legal registration." It investigates and verifies the professional records of engineers and issues certificates of qualification that, whenever legally possible, are expected to be recognized "as prima facie evidence of qualification in lieu of examination." Certain states specifically provide in their registration laws for the acceptance of these certificates; the Bureau, however, assumes no responsibility to its applicants to secure their legal registration in any state. The certificates might also be used, the bulletin suggests, "in connection with the award of professional degrees by engineering schools, for presentation to clients when soliciting contracts for professional services, and for presentation to employers when applying for positions."

The Bureau operates as a function of the National Council of Engineering Examiners, with an advisory board of representatives from seven national engineering societies, among which is the American Society of Civil Engineers. Its certificates are issued only to applicants who fully comply with its requirements and regulations. Application for the certificate must be made on forms pre-

scribed by the Bureau, and in states having registration laws the papers must be filed with the secretary of the state board of registration or examiners. Applicants living in states having no such laws should send their papers direct to the National Bureau of Engineering Registration, P. O. Drawer 1404, Columbia, S.C.

Board Members Receive Certificates

AN INNOVATION was introduced at the conclusion of the year's meeting of the retiring Board of Direction. Each outgoing member received an engraved certificate bearing witness to his service, similar in appearance to Past-President Tuttle's certificate reproduced here. Each year the departing Board members carry with them happy memories of a term of service to the Society and of the warm friendships that have developed in the course of this work. The bestowing of a certificate gives especial point to these recollections by affording a perpetual reminder.

SOCIETY CERTIFICATE AWARDED PAST-PRESIDENT TUTTLE

The personal value of such certificates to members of the Board is considered very real and the custom begun this year bids fair to become a welcome ceremony with each successive annual Board meeting. As the outgoing members made their final remarks, each received his certificate from President Tuttle. In turn, President Tuttle was presented with a similar document by the incoming President, D. W. Mead.

Freeman Scholarship Again Open

ONCE AGAIN it becomes the privilege of the Society to receive applications for the coveted Freeman Traveling Scholarship in hydraulics. This award, made possible through the generosity of the late John R. Freeman, Past-President and Honorary Member of the Society, provides for a year's study in the hydraulic laboratories of Europe. The successful candidate in this year's competition will be the tenth recipient chosen by the Society since the establishment of the fund.

Applicants for the scholarship must be American citizens between 24 and 35 years of age. They must have been graduated from a recognized engineering school and should have the professional status of a junior teacher. Membership in the Society is considered advantageous. The qualifications are described more fully, and the method of making applications is explained in detail in a mimeographed announcement available on request at Society Headquarters.

Applications will be received up to June 1, 1936, and the selection will be made promptly thereafter. It may be possible for the successful candidate to take up his studies as early as the first of July. There is considerable work involved in preparing the application, and those interested and eligible should take advantage of this early announcement to begin it at once.

Waterway Clearances Receive Board Attention

ACTING upon recommendations from the Engineering-Economics and Finance Division, the Board of Direction at its January 13, 1936, meeting adopted the following resolutions:

"That the United States War Department be requested to publish for the information of engineers in general a complete list of all present bridges over navigable waters, with complete information concerning horizontal and vertical clearances."

"That, to govern the requirements of clearances for structures over navigable waters the Board of Direction of the American Society of Civil Engineers endorses the following broad principles: 'Proper clearances for navigable waters are those that will not interfere with the operation of either land or water transportation, cause unwise expenditure to be made for physical readjustments, or place burdensome restrictions on future expansion. There must be an economic balance in the interest of both land and water transportation.'"

These recommendations emanated from the Committee of the Engineering-Economics and Finance Division on Standardization of Waterway Clearances, through a subcommittee consisting of Walter M. Smith, chairman, and Alonzo J. Hammond, Albert F. Reichmann, and Robert H. Ford, Members of the Society. The subcommittee observed that very few published data were available to give information as to waterway clearances of existing bridges or as to the rules governing various conditions.

Seattle Section Upholds Licensing Restrictions

A RESOLUTION unanimously adopted at the January 20, 1936, meeting of the Seattle Section of the Society requests the Washington State Committee of Engineering Examiners to adopt the following definition for the term "practice of professional engineering," appearing in the 1935 engineers registration act of that state:

"The responsible charge of engineering work requiring technical knowledge and skill acquired through education and/or experience over a period of at least seven (7) years, as required in the first 28 lines of Section 5, paragraph (*d*) of the act (as printed and issued by the Department of Licenses in 1935)."

The purpose of this resolution is to clarify that clause of the registration act which makes eligible for registration without examination citizens engaged in the practice of professional engineering for one year immediately prior to the taking effect of the act, but does not define specifically the term "practice of professional engineering." In the absence of a definition similar to that proposed, it is feared that the door may be opened to the registration of some who could not otherwise meet the requirements of the act's general provisions.

BETWEEN SESSIONS AT THE SPRING MEETING, MEMBERS MAY TAKE THEIR EASE ON A SUNNY VERANDA OR LIMBER UP ON THIS TRICKY HOT SPRINGS COURSE

Spring Meeting to Be Held in Hot Springs, Ark.

A PROGRAM particularly appropriate to the locality is being prepared for the Spring Meeting of the Society, scheduled to convene in Hot Springs, Ark., on Wednesday, April 22, 1936.

The principal feature of the opening session will be an address on the engineering problems of the Lower Mississippi Basin. It will be followed in the afternoon by a comprehensive symposium on the major factors in the development of the Mid-South. Particular consideration will be given to the problems confronting the industries and railroads of that region, and to a review of the possibilities of its undeveloped resources. One paper will be devoted to a discussion of the engineering and economic aspects of the production of gas and oil.

For Thursday, April 23, Technical Sessions have been arranged by the Waterways, Construction, and Sanitary Engineering Divisions.

For Friday, an excursion has been planned to the historic Greenville Bends of the Mississippi River, where recently completed cut-offs have taken 30 miles out of a former 40-mile length of channel. The scheduled events of the meeting will be concluded on Saturday with an inspection trip to a bauxite mine near Hot Springs.

The fame of Hot Springs as a resort city makes it almost superfluous to call attention to the varied possibilities for entertainment for both members and their ladies. There are many short sightseeing trips of interest, as well as possibilities for golf and other sports. In addition, a dinner dance has been arranged for the first evening, and other social events especially for the ladies are on the calendar.

A detailed program of the meeting will be published in the April issue of CIVIL ENGINEERING.

Federal Control Over Streams Discussed at Board Meeting

THE ADVISABILITY of having the federal government limit its control over the streams of this country was discussed by the Society's Board of Direction at its January 16, 1936, meeting. The outgrowth of the exchange of views in the Board was the adoption of a resolution in the following terms:

"*Resolved*, It is the judgment of the Board of Direction of the American Society of Civil Engineers:

"1. That for the present no further extension of federal control over streams is desirable; that the federal government should restrict its activities in this field to the functions of fact-finding and coordination and stimulation of state and interstate programs, and that initiation, administration and financing of projects should be reserved for state and interstate action, and

"2. That this expression of policy be communicated to the Society's Committee on National Water Policy, and that that committee be authorized to let this expression of policy be known if and when legislation is introduced in the Congress of the United States to place the control of pollution of water under the federal government, and

"3. That American Engineering Council be advised of the above expression of policy and be asked to assist in making it known as may appear practicable or helpful."

Los Angeles Junior Forum Now in Its Fifth Year

SINCE its organization in 1930, the Junior Forum of the Los Angeles Section has provided a splendid opportunity for Juniors to enter into professional activities. The forum is held immediately preceding the regular monthly dinner of the Section, and is conducted by the Juniors themselves. An executive secretary, originally elected for six months, handles all business and arranges the programs. This officer now serves a full year. Horace P. Hinckley, former executive secretary, has furnished the following account which is thus made available to other Local Sections where such junior activity may not yet be under way.

Talks generally deal with some phase of engineering work on which the speaker is employed or in which he is particularly interested. Hydraulic and construction problems have formed the subject matter of most of the addresses. However, topics have varied from the mechanics of traffic signals to engineering references in the Bible. Occasionally slides or motion pictures of a semi-technical nature have been included. As all expenses are taken care of by the Los Angeles Section, no dues are necessary.

In addition to Juniors, visitors from Student Chapters and Corporate Members of the Section sometimes attend the meetings. While the attendance has been small in the past, the men that do come have enjoyed and profited by the programs. Furthermore,

the forum has done much to make the Juniors realize that they are an integral part of the Section and of the Society and that here is an activity which they can at once conduct and participate in. It is hoped that more eligible Juniors will profit by participation in the meetings in the future.

Engineering Presidents Attend Montclair Society Meeting

SIX PRESIDENTS of engineering societies attended the January 3, 1936, meeting of the Montclair Society of Engineers, Montclair, N.J., and contributed, as spokesmen for their respective organizations, views on the changing conditions of society. The growing importance of the engineer in public affairs and the necessity for calm, systematic thinking in politics and government were discussed in a symposium on "Ways That the Engineering Societies Can Serve."

Beginning with an outline of the national progress of engineering education, the symposium showed that engineers can lend valuable aid in the management of public affairs, whether municipal, county, state, or federal, and that where they have already taken such a part they have proved their worth in the reduction of extravagance in public funds. The engineer is trained to achieve his predetermined goal through the most efficient means and in the most direct manner. This quality public managment could well afford to emulate. Each local engineering society constitutes a nucleus for action. The engineer should take an interest in his town's affairs not only as a professional man but also as a taxpayer. On no other occasion, it is believed, have so many engineering presidents congregated to join in advocating these principles.

A NOTABLE GATHERING OF ENGINEERING PRESIDENTS

Seated, Left to Right, Are Admiral George H. Rock, President of the Society of Naval Architects and Marine Engineers; Arthur S. Tuttle, Retiring President of the American Society of Civil Engineers; and Edward B. Meyer, President of the American Institute of Electrical Engineers. Standing, Left to Right, Are J. M. Lovejoy, Incoming President of the American Institute of Mining and Metallurgical Engineers; Frederick D. Herbert, President of the Montclair Society of Engineers; and William L. Batt, President of American Society of Mechanical Engineers

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

MODIFICATION IN PROGRAMS OF EMERGENCY AGENCIES

NATURAL FORCES of recovery are beginning to be felt, and the trend is to take engineering work out of a "relief" concept and place it on the more normal business basis.

The Chief Engineer of the Works Progress Administration, for example, has been charged with the responsibility of reviewing all applications covering major construction and eliminating those unsuited to the work of the Works Progress Administration. These include the following six "sieves":

1. Any construction project having a total estimate cost of $500,000 or more;
2. All building construction or reconstruction projects involving any single unit having a total estimated cost of $100,000 or more;
3. Water conservation, flood control, erosion prevention, park and other similar projects which contemplate the construction of one or more units, such as dams, swimming pools, or buildings which are estimated to cost $100,000 or more;
4. Projects for water supply systems, sewerage systems, or sewage disposal installations involving any plant or other single unit of construction costing $100,000 or more;
5. Projects for road construction estimated to cost $20,000 or more per mile or which involve any bridge, viaduct, or culvert estimated at $100,000 or more. Projects for landscaping, drainage, or other work along existing roads estimated to cost $10,000 or more per mile; and
6. Projects for airports estimated to cost $200,000 or more, or which involve structures costing $100,000 or more.

The WPA Engineering Division is also instructed to determine:

1. That its projects are satisfactorily designed from an engineering standpoint, or that arrangements for satisfactory design have been made which will enable the project to be undertaken promptly;
2. That the project is suitable for prosecution by force account;
3. That the man-year cost is not excessive, considering the locality and the relief labor load to be taken care of in the state concerned;
4. That the unit costs used in the estimates are reasonable; and
5. That the project can be carried on at a rate which makes completion possible within the estimated time.

ENGINEERING EXECUTIVES IN GOVERNMENT ADMINISTRATIVE DEPARTMENTS

Letters to the President of the United States and to the Secretary of the Interior have been written by President Potter of American Engineering Council, urging the appointment of an engineer-executive of high standing, as commissioner of the Bureau of Reclamation, a vacancy in the government service created by the sudden death of Dr. Elwood Mead. Assurances have been given that this post will be filled by a person of high capacity.

It should be made clear that Council has presented this case, not on the basis of recommendation of any specific individual but on the consistent principle that administrative positions in the government should not be filled by political appointees. It should further be stated that this action of Council is not only in line with past policy of Council, but upholds the principle of the merit system in public service.

In this connection, one of the most constructive thoughts expressed regarding efficient government administration on the occasion of the 53rd Anniversary of the Civil Service, came from Harry B. Mitchell, president of the Civil Service Commission of the United States. In substance, he said that the determination of policy—"What the Government Shall Do"—is a separate function and should be placed in the hands of those officers who usually change after an election. On the other hand, he stated, competent administration demands continuity of service carried on by well-

trained employees who know what steps to take to put those policies into action.

ACTIVITIES OF COUNCIL

The work of Council is carried out, first, through the agency of a paid staff at the Washington headquarters, and second, by a group of committees appointed annually by the president. Long-standing policies of Council call for no new expression by committees, but the considered opinion of the members of Council is developed through the year by its several committees and provides the basis for staff action.

American Engineering Council committees have been divided into four groups. The first is that of the "committees on public affairs." In this group subcommittees have been set up in aeronautics, public works administration, relation of engineers in private practice to government, conservation and utilization of national resources, patents, surveys and maps, regional activities, and rural electrification.

A second group of committees under a general chairman is entitled "committees on engineering and economic surveys." Under this head subcommittees on the balancing of economic forces and on special studies have been projected.

The third group of committees combines the activities of earlier major committees and subcommittees and has been called "committees on programs for united action of member organizations." Under this third group of committees, subcommittees on publicity for the profession, economic status, merit system in the public service, and survey of the engineering profession have been approved. It will be observed that three new committees have been established. The object of these committees, the first three mentioned in this paragraph, is to seek to coordinate for a common sense of direction activities now being handled in some cases by special committees of member organizations. The committees of Council are not to supplant the effective work of such committees, but rather to provide a common meeting ground for all those interested with the object of securing a larger accomplishment through collective action, wherever this is practicable. These committees grow out of the expressed wish of one or more members of Council to explore these fields for common action for the common good of the profession.

The fourth group of committees constitutes the "American Engineering Council operating committees," and includes the Executive Committee, the Finance Committee, the Membership and Representation Committee, the Committee on Constitution and By-Laws, and that on Publicity for American Engineering Council.

From time to time, the activities of these various committees will be reported in this news letter. In addition, it is proposed that the work of the public affairs committees and of the state and local public affairs committees, will be coordinated and expedited by a special news letter made up in part of the present "Engineering Embassy Service" and restricted, as now, to a limited list of officers and committee members of member organizations.

The general news letter, as now, will receive a wider distribution, especially through the cooperation of the editors of the publications of our member societies and of the general technical press.

Washington, D.C.
February 1936

Contractors' Association Recommends Technical Directors for PWA

AMONG other proceedings at the Seventeenth Annual Convention of the Associated General Contractors, held in Miami, Fla., January 13 to 15, 1936, a resolution was adopted recommending to Harold L. Ickes, Public Works Administrator, that in any reorganization of PWA field offices and in the selection of field administrators, experienced and qualified persons of engineering and architectural training be utilized. The text of the resolution, which was forwarded to Colonel Hackett, Deputy Administrator, and to Society headquarters as well as to Secretary Ickes, is as follows:

"WHEREAS, the planning and administration of Emergency Public Work under the jurisdiction of PWA has been handled expeditiously by state directors of engineering and architectural training; and

"WHEREAS, information now at hand indicates that in the reorganization of field offices under PWA, and in the selection of administrative directors those possessing such engineering and architectural training might not be assigned to these important positions;

"*Therefore, be it resolved* by the Associated General Contractors of America in Convention assembled, January 13–15, 1936, at Miami, Florida, to recommend to the Administrator of Public Works that these positions be filled by experienced and qualified persons of engineering and architectural training."

Engineers' Council Issues Third Annual Report

ANNOUNCEMENT is made that the Third Annual Report of the Engineers' Council for Professional Development is just off the press. The Society is a member body of this organization. The report is an attractively arranged 36-page pamphlet containing the reports of the committees on student selection and guidance, engineering schools, professional training, and professional recognition. University extension facilities are listed, and a reading list for young civil engineers is suggested. The report also includes a digest of engineer registration laws prepared as an appendix to the 1935 report of the committee on professional recognition.

Copies of the report may be obtained at a cost of 25 cents each from the Engineers' Council for Professional Development, 29 West 39th Street, New York, N.Y.

In and About the Society

AT the January Board meeting a number of visits were reported by Board members and Society officers, all since the previous Board meeting in October. Various officials, mostly members of the Board and totaling 15 persons, participated in 33 visits to Local Sections, 36 to Student Chapters and 10 to other meetings. By far the largest number of these were made by Field Secretary Jessup continuously between October 21 and December 19.

The major objective of these visits is to afford the members of the Section or the Chapter a more intimate understanding of what the Society is doing for its members and for the profession. Incidentally a more personal relationship between the Society's members and its officers is developed to the benefit of all.

* * *

The Collingwood Prize for Juniors and the Alfred Noble Prize have long been considered an incentive to stimulate technical activities by younger members. But they have not wholly accomplished their purpose, as witnessed by the fact that the former has been granted only 10 times in the past 15 years, and the latter has not been awarded in either 1934 or 1935 because no paper has been deemed worthy.

As possibly indicating an improvement in this trend, it may be noted that both technical papers featured in the current February PROCEEDINGS are by Juniors—on "Behavior of Stationary Wire Ropes in Tension and Bending," by Douglas M. Stewart, and on "Varied Flow in Open Channels of Adverse Slope," by Arthur E. Matzke.

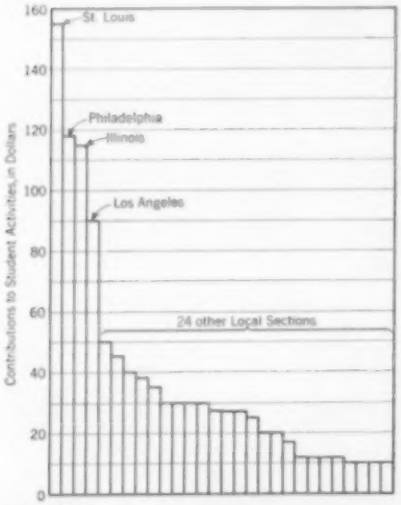
Engineering Foundation Elects Officers

ENGINEERING FOUNDATION, the joint organization of the Founder Societies for research and related activities, has announced its officers for 1936. H. P. Charlesworth continues as chairman; D. Robert Yarnall was elected vice-chairman; and Alfred D. Flinn, M. Am. Soc. C.E., retains his post as director and secretary.

The board of the Foundation is elected by United Engineering Trustees Inc., and consists of five of the trustees, two representatives of each of the Founder Societies (nominated by their respective governing bodies), and three members at large. Trustees selected for the board include Otis E. Hovey, M. Am. Soc. C.E., and A. L. J. Queneau, George L. Knight, H. P. Charlesworth, and D. Robert Yarnall. The new members representing the American Society of Civil Engineers are George E. Beggs and Langdon Pearse.

Student Chapters an Important Phase of Society's Activity

A GLANCE at the membership records of the Society suggests that the Student Chapters are contributing in large measure to the development of a professional attitude among young engineers. From the best estimate available, it appears that some 90 per cent of the Juniors admitted to the Society in 1935 were former members of such groups. Considering all classes of membership, well over half the applicants have had their first contact with the Society through the student organizations. In view of these facts a brief review of the status of the Student Chapters, taken from the report of the Committee on Student Chapters, should be of interest to every member. Some data on the support given the student groups by various Local Sections has also been included.



CONTRIBUTIONS OF 28 LOCAL SECTIONS TO STUDENT PRIZES AND ACTIVITIES IN 1934

Later Figures Are Not Available. In the 1934 Reports, No Other Local Sections Indicated Contributions of This Nature

A total membership of 4,308 was enrolled in the 111 Student Chapters active during the academic year 1934–1935. The average number of meetings per Chapter was 11, and the average attendance at these meetings was 38.

Perhaps the most outstanding feature of the programs was the extent to which students themselves took part. Of all the papers and lectures presented, 615 (45 per cent) were by students. In addition of course, student officers presided at most of the sessions and carried on the major part of the administrative work of the Chapters.

Outstanding work on the part of 13 Chapters was recognized by letters of commendation from President Tuttle on January 14, 1936. The Chapter at the Oklahoma Agricultural and Mechanical College was singled out as having made conspicuous progress in the conduct of its affairs during 1934–1935; 12 others were complimented on general efficiency and merit. The Chapters thus honored are listed in Table I.

WHAT LOCAL SECTIONS ARE DOING FOR STUDENT CHAPTERS

Credit for part of the progress made by Student Chapters is due to the Local Sections that have contributed money for prizes and student activities. The accompanying diagram, based on reports of Section expenditures for 1934, needs little explanation. Later figures, if available, would show a greater number of Sections contributing, and, in some cases, larger contributions.

The purposes for which these allotments are spent are of course determined by the individual Local Sections. Some of the prizes are for student papers, but most of them, consisting of one year's Junior dues in the Society, are awarded for high scholastic standing or on a combined basis of scholarship and participation in student affairs. The New Mexico Section, for example, uses a formula devised by H. C. Neuffer, M. Am. Soc. C.E., to determine the recipient of its prize. Student members near the end of their senior year are rated by the engineering faculty as to scholarship, activities, and aptitude. A grade of "A" in all courses taken during the junior and senior years is worth 60 points, and lower grades are given proportionate values. To the score determined from grades, activities can add a maximum of 30 points. For example, 3 to 8 points are given for service as engineering reporter on the student paper; the exact number depends upon the interest taken and the amount of work done. Finally, the student who stands highest in aptitude, in the opinion of the faculty, is given 10 points, and the other students receive proportionate ratings. The prize is awarded the student with the highest total score.

In addition to membership prizes, the Louisiana Section in 1934 gave a $40 scholarship at Louisiana State University, and the following year set up a similar award at Tulane. The St. Louis Section, on the other hand, spends most of its student allotment on establishing a close contact between the Section and the three Student Chapters in the vicinity. Annually the seniors of the Chapters are entertained at a Section banquet, and annually the Section holds one meeting at each of the three schools—one of them more than 120 miles from St. Louis. Several other Sections make it possible for students to attend their regular dinner and luncheon meetings by charging them half price and paying the remainder from the Section funds.

There are doubtless many other arrangements made by Local Sections for aiding the Student Chapters in their vicinity. The editors of CIVIL ENGINEERING will be glad to have their attention called to such projects.

Society Represented at A.A.A.S. Convention

ENGINEERS at the 97th Convention of the American Association for the Advancement of Science, held in St. Louis, Mo., December 30, 1935, to January 4, 1936, devoted one session to the question, "Shall the engineering profession formulate a philosophy of social welfare?" Gen. Robert I. Rees discussed the necessity for such a philosophy, and Dr. C. F. Hirshfeld stressed the importance of developing it along thoroughly practicable lines. Karl T. Compton, president of the Association, reviewed the work of the Engineer's Council for Professional Development. The meeting was presided over by E. O. Sweetser, M. Am. Soc. C.E.

F. W. Green, M. Am. Soc. C.E., who represented the Society at the convention, has submitted an interesting report that includes some 40 pages of clippings from the St. Louis papers. Mr. Green comments on the important service performed by the Association's publicity organization in providing the press with usable and reliable information. The complete report is available for consultation at Society Headquarters.

TABLE I. CHAPTERS RECEIVING LETTERS OF COMMENDATION FOR OUTSTANDING PERFORMANCE

NAME OF CHAPTER	NUMBER OF MEETINGS	AVERAGE ATTENDANCE	PAPERS OR LECTURES				MEMBERSHIP	
			By Students	By Faculty	By Others	Am. Soc. C.E. Illustrated Lectures	Total Actual	% of Those Eligible
Oklahoma Agricultural and Mechanical College	16	28	4	3	2	3	50	76
Carnegie Inst. of Technology	39	70	19	1	19	1	65	100
Illinois, Univ. of	20	203	..	1	16	..	198	72.9
Iowa State Coll.	12	70	2	..	3	1	60	39.4
Brooklyn Polytechnic Inst.	7	31	..	1	6	..	208	100
Lehigh Univ.	7	58	1	1	6	..	35	49
New Hampshire, Univ. of	26	28	54	2	7	..	25	100
Kentucky, Univ. of	30	39	3	7	14	4	39	100
Tulane Univ.	17	16	..	1	16	..	19	65
Virginia Military Inst.	20	86	35	5	12	..	86	100
Kansas State Coll.	13	58	3	8	6	2	60	100
Montana State Coll.	18	50	35	2	1	..	67	98
Stanford Univ.	22	19	..	2	10	..	36	72

Preview of Proceedings

By HAROLD T. LARSEN, *Editor*

A symposium, three notable progress reports of Society committees, several closing discussions, and an unusual accumulation of new discussions combine to make the March number of "Proceedings" the largest since May 1935.

SURFACE AND SUB-SURFACE INVESTIGATIONS, QUABBIN DAMS AND AQUEDUCT: A SYMPOSIUM

In a foreword to this symposium, Frank E. Winsor, M. Am. Soc. C.E., presents the broad problem of supplying water for the city of Boston, Mass., as a background for the two major papers in the symposium.

PERMEABILITY DETERMINATIONS, QUABBIN DAMS

In the past decade the art of designing and constructing earth dams on permeable foundations has progressed by leaps and bounds under the impetus of an active corps of scientific investigators in this field. A significant phase of this type of investigation is that much of it is conducted on a large scale by studying the prototype itself.

In a paper for the March PROCEEDINGS entitled "Permeability of Foundations for Earth Dams," Stanley M. Dore, Assoc. M. Am. Soc. C.E., has offered to the Society the results of his observations and those of his colleagues on the construction of two dams for Quabbin Reservoir in Massachusetts, which is an important integral part of the water system for the city of Boston and 19 neighboring cities and towns. Both of these structures are designed as earth dams placed by hydraulic methods, the dam over the Swift River being about 2,640 ft long and 160 ft high above the original ground surface and the other dam, or "dike," over Beaver Brook being 2,140 ft long and 135 ft high above the original ground surface. The first dam contains 4,000,000 cu yd of embankment, and the dike contains, 2,500,000 cu yd. The paper consists of two parts. Part one deals with determinations of permeabilities of the foundations for these dams obtained by classifying, analyzing, and testing bore hole samples; and part two, with determinations made by observing the effect of pumping upon the ground-water gradients in the foundations.

The accompanying photograph shows the construction of a concrete caisson core wall for the main dam and, in the foreground, the discharge piping from pumps in the caissons for lowering the ground water in the foundations. The permeability of these foundations was estimated from the amounts that the ground-water surface was lowered by this pumping. The position of the ground-water surface before pumping was approximately at the tops of the caissons in the foreground.

CONSTRUCTION VIEW LOOKING EAST ALONG THE CENTER LINE OF CORE WALL FOR THE MAIN DAM, QUABBIN RESERVOIR

GEOLOGIC FEATURES OF THE QUABBIN AQUEDUCT

The Boston, Mass., metropolitan water supply addition is dependent upon an aqueduct approximately 25 miles long, which will connect the new Quabbin Reservoir with Wachusett Reservoir. In planning a tunnel project, an imposing list of questions confronts the engineer. Among others, the author, Frank E. Fahlquist, Assoc. M. Am. Soc. C.E., in a paper in the March PROCEEDINGS, names the following: Of several tunnel locations, is there any geological reason for choosing one line rather than another? Which parts of the location require exploratory investigation beyond what can be determined by field inspection of the surface topography and rock ledges? After preliminary borings have been made, can one tell whether the purpose in each case has been fully met, or are additional explorations necessary? What is the maximum depth of buried pre-glacial stream channels crossing the tunnel line, as bearing on the grade of the tunnel? Would a shift of the line avoid any uncertainty as to buried channels, and so end the question of further exploration? Can shafts be located at comparatively low spots and, at the same time, be reasonably distributed and yet avoid locations where the cover is heavy or where troublesome conditions may occur? How many different rock formations are likely to be encountered; what is their individual character, structural relation, and sequence; and what are the practical differences as affecting progress of the work and safety of the structure?

These are some of the questions that a geologist has in mind during his studies, and the paper by Mr. Fahlquist is a treatment of the manner in which these questions were met and answered in one tunnel project. The paper, furthermore, contains valuable cost data and statistics pertaining to drilling and blasting performance, which are correlated with the geology, on a construction job of major proportions.

"STRUCTURAL ALLOY AND HEAT TREATED STEEL," PROGRESS REPORT OF SUBCOMMITTEE NO. 2, COMMITTEE ON STEEL OF THE STRUCTURAL DIVISION

Reference to the Society's *Year Book* for 1935 (page 14) reveals the fact that the Structural Division's Committee on Steel conducts its program of research through three active subcommittees. The forthcoming report of Subcommittee No. 2 on Structural Alloy and Heat Treated Steel merits the careful study of every structural engineer in that it "scratches below the surface," figuratively, and reports comprehensively on the metallurgy of the newer type of structural steel. The avowed purpose of this Committee is "to survey and report upon the economy and appropriateness of various categories of alloy and heat treated steel for structural engineering purposes, with recommendation for field of use, methods of test, etc., to insure maintenance of the qualities specified and for the design stresses." The forthcoming report runs the entire gamut of these aims, dealing first with high strength steels classified according to their principal alloying element as, for example, silicon steel, nickel steel, chromium, vanadium, molybdenum, copper steel, and manganese steel.

Finally, the report ends with a discussion of the economic status of high strength steels in general, summarizing with three conclusions as follows: "(1) There are quite a number of steel types available, most of which have been employed in more or less important structures; (2) at the present time there are many new types and more complex types being considered; (3) high strength structural steel may, therefore, be considered as passing through a transition. With such a status it is becoming increasingly apparent that not much is known yet about their full properties or their true economy." These conclusions are supported by further descriptions of furnace operations, rolling, fabricating costs, mechanical properties of the finished product, and other subjects that will guide the designer, the fabricator, the manufacturer.

"WIND BRACING IN STEEL BUILDINGS," SEVENTH PROGRESS REPORT OF SUBCOMMITTEE NO. 31, COMMITTEE ON STEEL OF THE STRUCTURAL DIVISION

The Structural Division's well-known Committee on Wind Bracing in Steel Buildings, in its Fifth Annual Report of Progress, presents some interesting and valuable information on forces exerted by wind velocity. The report is divided into five parts as follows: (1) Comments on the Discussion of the Third Progress Report; (2) Wind Force on Rounded and Sloping Roofs; (3) Allocation of

Wind Force to the Windward and Leeward Walls; (4) Simplified Methods of Determining Wind Moment; and (5) Experimental Studies of the Behavior of Wind Forces.

In two interesting sets of curves, the Committee presents comparisons of the external pressures found by various observers for curved roofs as well as for peaked roofs, and ends by making tentative recommendations for design purposes based on a careful study of the data reported. With the footnote references accompanying this report, the Committee has produced a thorough guide, furthermore, to the study of the subject.

The report to be published in a forthcoming number of PROCEEDINGS, will be open for discussion, and comments on it will be published in subsequent numbers of PROCEEDINGS.

"WATER SUPPLY ENGINEERING," PROGRESS REPORT OF THE COMMITTEE OF THE SANITARY ENGINEERING DIVISION

The Sanitary Engineering Division's Committee on Water Supply Engineering has been established as a very useful reporting agency designed to prevent the Society's work in the field of water supply engineering from being merely a repetition of work being done just as well by other agencies. Its first report was published in PROCEEDINGS for December 1934, Part I being a report on the activities of organizations interested in water supply, which was submitted in January 1933. Part II was in reality the second progress report dealing with the status of the art of water supply engineering presented by the Committee the following year, January 1934.

The forthcoming report contains a concise and valuable résumé of the important projects in the United States dealing with water supply engineering. This report is characterized by complete footnote references to articles on the subject mentioned in the report.

CLOSING DISCUSSIONS

In addition, it is planned to publish the closing arguments of a number of papers, the discussions of which have attracted wide interest. Among the closures that are now ready are the following: "Some Low-Temperature Characteristics of Bituminous Paving Compositions," by Hugh W. Skidmore, Assoc. M. Am. Soc. C.E.; "Live Load Action in Thin Cylindrical Shells," by Herman Schorer, Assoc. M. Am. Soc. C.E.; and "Structural Beams in Torsion," by Inge M. Lyse, M. Am. Soc. C.E., and Bruce G. Johnston, Jun. Am. Soc. C.E.

Kansas City Section Urges Engineers to Widen Interests

MEMBERS of all grades of the Society resident in the vicinity of Kansas City have received a form letter over the signature of Robert P. Woods, M. Am. Soc. C.E., president of the Kansas City Section, calling their attention to the importance of a cooperative effort to increase their standing in the community. The advantages of membership in the Kansas City Section are presented, and the letter continues with the following:

"It is not here intended to convey an impression that big things are to be done, or that radical changes be made. It is sought rather to have the Civil Engineers uphold their own in the scheme of things; to be considered what they are, through their abilities and efforts. Individually some have stepped up, but by cooperation the group could advance in knowledge and esteem.

"To those engineers whose duties have become more executive, and to those partially retired, may it be said with deference that they have a duty in perpetuating the technical association that served to mark them engineers of recognized ability, if not of distinction. The younger engineer needs the stimulus of the ideas of the older ones, and the older would do well to heed those of the younger."

Civil engineers throughout the country are undoubtedly taking a greater interest in public affairs. But more active cooperation is needed. In this connection it should be noted that the Society's Local Sections constitute centers for self-expression as well as mediums for the advancement of technical knowledge and the maintenance of a high professional standing.

New Papers Recently Filed in Library

SINCE December 1935 the following papers of interest to civil engineers have been placed for reference in the Engineering Societies Library. The originals can be examined there, at 29 West 39th Street, New York, N.Y., and estimates of the cost of photostatic copies will be given by the Library on request.

ACTION OF CORNER PANELS ON FLAT SLAB

HAWORTH, H. S., Assoc. M. Am. Soc. C.E., and MASON, MORRIS, Jun. Am. Soc. C.E., "A Study of the Action of Corner Panels of a Flat Slab Under Load" (about 2,800 words). The paper gives the results of loading tests made by the authors on two corner panels of a floor of two-way flat-slab construction. The work was done primarily to obtain, by means of deflection measurements, data on the actual strength of the slabs. Load was applied by filling empty oil storage tanks with water. Diagrams showing the resulting deflections and cracks accompany the paper.

THE PORT OF LOS ANGELES

FITZGERALD, GERALD C., Assoc. M. Am. Soc. C.E., "The Port of Los Angeles" (about 17,500 words). This paper, presented before the Waterways Division of the Society at Los Angeles, Calif., on July 4, 1935, was abstracted in the September 1935 issue of CIVIL ENGINEERING. The full manuscript includes a historical review, a general description of the port facilities, a discussion of the comprehensive plan of development, an analysis of port commerce, and considerable economic data.

STUDIES OF OSCILLATIONS IN SOIL

BARKAN, DOMINIC (two papers), "Relation Between the Damping of Oscillations in Soil and the Regimen of the Source of Oscillations" (about 1,800 words of text, with 5 tables and 5 figures), and "On the Problem on Soil Resonance" (about 700 words). Tests with a vibratory machine and a seismograph indicated that the capacity of a soil to absorb the energy of oscillations being propagated on its surface is little affected by their amplitude, but does appear to depend on their period. A formula is presented for computing the amplitude of vibrations at any point on the soil surface as a function of amplitude and period of the source, and the coefficient of damping of the soil in question. The author is senior scientific collaborator of the Institute for Structural Foundation Research, Moscow, U.S.S.R.

News of Local Sections

BUFFALO SECTION

Daniel W. Mead, newly elected president of the Society, was guest of honor at a special meeting of the Buffalo Section held at the Buffalo Club on January 28. The principal address was given by Dr. Mead, who stressed the duty of the Society to instill high ideals in its younger members. Other speakers were Edward P. Lupfer and C. Arthur Poole, respectively Vice-President and Director of the Society. There were 52 present.

CLEVELAND SECTION

A dinner preceded the annual meeting of the Cleveland Section held on January 14. During the meeting the newly elected officers for 1936 were introduced to the members, the list of these officers being as follows: Charles H. Splitstone, president; Arthur F. Blaser, vice-president; and Frank L. Gorman, secretary-treasurer. The feature of the occasion was an address by the Hon. Harold H. Burton, mayor of Cleveland.

COLORADO SECTION

The annual "Ladies Night" was celebrated by the Colorado Section on November 11, 1935, at the Olin Hotel in Denver. There were 111 present at the dinner and 20 extra at the meeting following. The committee on entertainment, under the chairmanship

of R. D. Welch, presented a program of music and motion pictures, the latter being shown through the courtesy of the General Electric Company. On December 9, 1935, a meeting of the Section was held at the Olin Hotel. The dinner was attended by 54 members and guests, and at the meeting following there were approximately 75. At the completion of the business session an interesting technical program was presented. On the list of speakers were J. R. Riter and O. C. Reedy, of the U. S. Bureau of Reclamation, and M. C. Hinderlider, state engineer of Colorado.

The tenth regular meeting of the Association of Junior Engineers of the Colorado Section was called to order on October 28, 1935, with 35 present. The speakers on this occasion were James J. Pitt, of the Denver Traffic Bureau, and S. D. Kelly, who is in the office of the manager of safety. There were 27 members and 8 guests present at a meeting of the association held on November 25, 1935. At this session W. A. Forstall, of Regis College, gave a talk on seismology, describing methods used in the recording and analysis of earthquakes and summarizing recent earthquake history in the region.

Dayton Section

The January meeting of the Dayton Section took the form of a luncheon meeting at the Engineers' Club, which was attended by 22. Following a brief business session, Dr. F. V. Riche, Dayton sportsman and amateur photographer, entertained the Section with his own motion pictures of the Northwest as well as with an interesting reel taken in Minnesota.

Detroit Section

A number of members of the University of Michigan Student Chapter were among the 90 present at a meeting of the Detroit Section held in Ann Arbor, Mich., on November 14, 1935. The meeting was in charge of Louis M. Gram, professor of civil engineering at the university. Professor Waite gave a talk on crime, and George T. Seabury, Secretary of the Society, also spoke. Seven of Michigan's outstanding engineers were among the 17 life members of the Detroit Section honored at a banquet given by the Section at the Hotel Statler in Detroit on January 31, 1936. Stories were told of the rise of the city and state in the various scientific and professional fields.

District of Columbia Section

On January 3 the District of Columbia Section held a meeting for the purpose of discussing Society and Section affairs. There were 42 present. On January 10 the Section participated in the annual good fellowship dinner of all the engineering organizations located in Washington. This affair was sponsored by the American Engineering Council.

Duluth Section

At its regular annual meeting held on January 6 the Duluth Section elected new officers for the ensuing year. These are as follows: John Carson, president; George W. Deibler, first vice-president; Ralph M. Palmer, second vice-president; John Carson, treasurer; and William E. Hawley, secretary.

Illinois Section

The annual meeting of the Illinois Section, held at the Chicago Engineers' Club on January 10, was addressed by John R. Fugard, who spoke on the subject of the Metropolitan Housing Council of Chicago. Officers for 1936 were elected at this session, W. G. Arn being president and J. G. Bennett, vice-president. George B. Massey will continue to serve as secretary.

Ithaca Section

On December 10, 1935, a joint meeting of the Ithaca Section and the Steuben Area Chapter of the New York State Society of Professional Engineers was held at the Mark Twain Hotel in Elmira, N.Y. The first speaker was Frank L. Bolton, president of the Cayuga Rock Salt Company, who discussed the subject of salt production. He was followed on the program by L. J. Ettinger, Jr., an engineer with the International Salt Company, whose topic was "The Use of Salt in Road Stabilization." C. D. Looker, director of research for the same company, helped to answer many questions on this subject. The attendance numbered 45. A meeting of the Section was held in Willard Straight Hall on the campus of Cornell University on January 21, 1936, with 29 members and guests present. Gilmore D. Clarke, professor of regional planning at Cornell University, was the speaker. He gave an illustrated talk on the West Side express highway in New York.

Los Angeles Section

The new officers for the Los Angeles Section are as follows: Gerald C. FitzGerald, president; H. Macy Jones and A. M. Rawn, vice-presidents; D. Arnold Lane, secretary; Milo C. Halsey, treasurer; and Merrill Butler and Alfred Jones, directors. On January 14 a joint meeting of the Section and local branches of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers was held. The speaker on this occasion was Donald R. Warren, for the past three years senior bridge field engineer on the construction of the San Francisco–Oakland Bay Bridge, who discussed various features of the project.

A meeting of the Section was held on February 12, with 92 present. The first speaker was Harry W. Dennis, newly elected Vice-President, who gave a brief résumé of the Annual Meeting of the Society held in New York in January. He was followed by Julian Hinds, who spoke briefly of his acquaintance with the late Elwood Mead, M. Am. Soc. C.E., in the U. S. Reclamation Service, and by John Server, executive secretary of the Junior Forum, who gave a report of recent meetings of the forum. An interesting feature of the occasion was the presentation of colored motion pictures of the Indians of Arizona and New Mexico by Burton Frasher of Pomona, Calif. The technical program was presented by J. M. Gaylord, chief electrical engineer of the Metropolitan Water District of Southern California, who described briefly the salient engineering features of the District. He also showed slides of the hydraulic laboratory at the California Institute of Technology, which was built by the District for purposes of experimentation.

Maryland Section

There were 45 present at a meeting of the Maryland Section, held at the Engineers' Club in Baltimore on January 28. The president opened the meeting with a discussion of the proposed Maryland law for the registration of professional engineers, citing the history of the committee appointed to consider the matter. Upon motions duly seconded and unanimously carried, the Section recorded its formal action as follows: (1) The enactment of legislation for the registration of professional engineers and land surveyors of Maryland is favored; (2) the proposed Maryland act, which is based on the Model Law, is approved, with the proviso that land surveyors are to be included in its provisions; and (3) the president of the Section is directed to invite each of the affiliated societies to delegate two representatives to confer with representatives of the Section, receive explanation of the proposed law, and take action thereon. At the conclusion of the meeting refreshments were served.

Metropolitan Section

The work of the United States Beach Erosion Board was outlined in a paper by Earl I. Brown, division engineer, South Atlantic Division, U. S. War Department, which was read at a meeting of the Metropolitan Section in New York City on January 22. Lantern slides showing recent changes in the shore line at Deal Beach, N.J., and other locations were used to illustrate the paper. Victor Gelineau, director and chief engineer of the Board of Commerce and Navigation of the State of New Jersey, then read a paper on coastal erosion and protection. A discussion of the problems of beach and property erosion followed, those participating being Sidney Shapiro, T. S. Scott, and Lt. Commander William M. Angas. The meeting was attended by about 300. On February 4 a joint meeting of the Section and the New York sections of the American Welding Society and the American Water Works Association was held in New York. Otis E. Hovey, treasurer of the Society, spoke on steel dams, with particular reference to the advantage of using steel in the construction of fixed dams.

On January 28 the Junior Branch of the Metropolitan Section held a meeting, which was devoted to a series of talks on the Triborough Bridge project, followed by a round-table discussion. At a meeting held on February 11, Secretary Seabury described the activities and organization of the Society. Several members of the staff were also present and described their work.

The February meeting of the Metropolitan Section was held in the Engineering Societies Building on February 19, 1936. There were about 300 members and guests present. The meeting was devoted to the topic, "Parkway Systems of New York City and Surrounding Territory." B. L. Van Schaick, executive secretary of the Long Island State Park Commission, of Babylon, L.I., presented a talk of genuine interest on this subject, which was illustrated with moving pictures in color. Following the talk, questions were asked from the floor. Refreshments were served after the meeting.

MILWAUKEE SECTION

A joint meeting of the Milwaukee Section and the Marquette University Student Chapter was held in Milwaukee on December 12, 1935. The speaker of the evening was C. S. Stewart, who gave a talk on the Grand Coulee Dam now under construction. Mr. Stewart showed motion pictures of the process of excavation and the mile-long belt-conveyor system for disposing of the earthwork in Rattlesnake Canyon and described the design of the mixers used on the work. The annual meeting of the Section was held at the City Club in Milwaukee on January 16, 1936. During the business session the following officers were elected for 1936: H. C. Webster, president; E. L. Knebes, first vice-president; L. J. Larson, second vice-president; and F. W. Ullius, secretary-treasurer. An interesting talk was given by Herbert L. Ebling, chief engineer of District No. 4 of the Works Progress Administration, who spoke on the topic, "Planning in Relation to the Works Program." R. C. Johnson, chief engineer of the Immel Construction Company of Font du Lac, Wis., then explained the work of the National Emergency Council and answered questions brought up by the members.

NORTH CAROLINA SECTION

A talk on traffic safety in North Carolina cities by G. C. Eichorn, director of traffic safety in Greensboro, N.C., was the feature of a meeting of the North Carolina Section held in Raleigh on January 25. This meeting was held concurrently with a session of the North Carolina Engineering Society. Frederick H. McDonald, Director of the Society, was present and spoke on the topic, "The Local Section as a Laboratory."

NORTHEASTERN SECTION

Student Chapter representatives from Harvard University, the University of Maine, Worcester Polytechnic Institute, Massachusetts Institute of Technology, and Tufts College were present at the annual meeting of the Northeastern Section held at the Engineers' Club in Boston on January 25. There were 79 in attendance at the meeting, which was preceded by a luncheon. During the business session the following new officers were elected: Howard A. Gray, president; Albert Haertlein, vice-president; and Francis H. Kingsbury, secretary-treasurer. The members of the executive committee are Harry P. Burden and John P. Wentworth. The speakers were President Mead, who spoke on Society matters; Field Secretary Jessup; and Donald McLaughlin, of the department of mining geology of the university. A special dinner meeting of the Section was held at the Engineers' Club in Boston on January 10, with 38 members and guests present. The speaker of the evening was Fred C. Scobey, senior irrigation engineer of the U. S. Department of Agriculture, who discussed the topic, "Western Water Conduits and Unusual Flow Conditions." His talk, which was illustrated with colored slides, was followed by a question-and-answer period.

PHILADELPHIA SECTION

Those who braved the cold to attend the dinner meeting of the Philadelphia Section held on January 24 were rewarded by an interesting program on the latest developments in transportation. The guests of honor were President Mead and Field Secretary Jessup. Dr. Mead gave an informal talk on the value of engineering societies to engineers and the need for inspiring young engineers with a high ideal of professional conduct. Earlier in the day Dr. Mead and Mr. Jessup had been welcomed to the city by Mayor Wilson, and a luncheon had been given for them at the Union League. This was attended by prominent representatives of engineering societies, leading industries, and civic organizations. Those appearing on the technical meeting program were John B. Tinnon, general sales manager for the Metal and Thermit Corporation of New York City, who spoke on "Thermit Welded Joints on Steam Railroads"; E. H. Brown, an electrical engineer for the Pennsylvania Railroad, whose topic was "The Electrification of Railroads"; and C. M. Hodell, Philadelphia district manager of the United Air Lines, who discussed the subject of air transportation. There were 52 at the dinner and 82 at the meeting. Charles H. Stevens, chief engineer of the Philadelphia Department of City Transit, was chairman.

PORTLAND (ORE.) SECTION

Election of officers for 1936 was a feature of the annual meeting of the Portland (Ore.) Section held on January 3. Those elected are as follows: James H. Polhemus, president; Charles A. Mockmore, second vice-president; and Geary Kimbrell, secretary-treasurer. Officers elected in 1935 whose terms carry through 1936 are C. H. Canfield, first vice-president, and Carl E. Green, secretary. The speaker was the Reverend Father John B. De Launay, dean of men at Portland University, who gave an account of his experiences and observations during a seven-year stay in India.

ROCHESTER SECTION

The Rochester Section enjoyed a number of meetings during 1935. On February 18 a dinner, followed by a business meeting and technical discussion, was held. A dinner meeting that took place on May 10 was addressed by S. L. Boothroyd, professor of astronomy at Cornell University. Field Secretary Jessup was the guest of the Section on November 9 and 10 and met various Section groups for discussion. At a dinner meeting held on November 16 Arthur S. Tuttle, then president of the Society, was guest of honor and speaker. On November 20 Howard M. Shafer, manager of the Rochester airport, spoke on modern airports. On February 7, March 28, April 11, and November 7 joint meetings with the Rochester Engineering Society were held. The speakers on these occasions were Edwin G. Speyer, consulting engineer for the Buffalo Planning Board and president of the Buffalo Section; R. R. Zipprodt, structural engineer for the Portland Cement Association; and W. F. Lockhardt, also with the Portland Cement Association. On September 28 and December 7 inspection trips were made to several points of local engineering interest.

SACRAMENTO SECTION

A series of luncheon meetings have recently been held by the Sacramento Section. At the meeting that took place on November 10, H. W. Dennis, newly elected Vice-President of the Society, and Charles Stockton Pope, former president of the Section, were the speakers. On December 3, George McDougall, California state architect, gave an interesting talk on ancient and modern architecture. One of the outstanding meetings of the year was that held on December 10. There were 80 members and guests present at this session, at which the speaker was A. D. Wilder, California state engineer for the Public Works Administration. On December 17 M. P. O'Brien, associate professor of mechanical engineering at the University of California, described the large-scale model of the mouth and estuary of the Columbia River recently completed in the hydraulic laboratory of the university. There were 59 members and 76 guests present at the annual Christmas meeting, held on December 24, which was devoted to an entertainment program of skits and music. A business meeting was held on December 31.

SAN DIEGO SECTION

At the December meeting of the San Diego Section the following officers were elected for the coming year: Edwin A. Ingham, president; L. L. Mills, vice-president; and C. Wayland Capwell, secretary-treasurer.

SAN FRANCISCO SECTION

There were 225 present at the second annual joint meeting of the San Francisco Section of the Society and the local chapter of the American Institute of Electrical Engineers held at the Engineers' Club on January 30. The technical discussion was devoted to the subject, "The Modern Ship and Its Equipment," the speakers on this symposium being A. J. Dickie and H. L. Westling. Mr. Dickie is editor of the *Pacific Marine Review*.

SPOKANE SECTION

The newly elected officers of the Spokane Section were in charge of a luncheon meeting of the Section held at the Davenport Hotel on January 9. These officers are as follows: M. K. Snyder, presi-

dent; C. A. Burnette, first vice-president; John Howard, second vice-president; and Philip G. Holgren, secretary-treasurer. The topic of discussion at this session was plans for the coming year.

South Carolina Section

The annual winter meeting of the South Carolina Section was held at the Columbia Hotel in Columbia, S.C., on January 9. During this business session Harwood Beebe was elected president of the Section for the coming year. The other officers will be J. H. Dingle, vice-president, and Albert E. Johnson, secretary-treasurer.

St. Louis Section

There were 27 members and guests present at a meeting of the St. Louis Section held at the Mayfair Hotel on January 27. An interesting talk on the engineering aspects of industrial hygiene was given by Scott Johnson, an engineer in the St. Louis Department of Health. Mr. Johnson spoke on the causes of occupational diseases and discussed the possibility of eliminating them by engineering means.

Syracuse Section

Charles S. Gleim, engineer of construction for the Port of New York Authority, was the guest of the Syracuse Section at a joint dinner meeting of the Section and the Technology Club of Syracuse, which was held in the Onondaga Hotel on January 27. Colonel Gleim gave an illustrated lecture on the construction of the Holland and Midtown tunnels in New York. There were about 100 present.

Tacoma Section

On January 13 a dinner meeting of the Tacoma Section was held in Weyerhaeuser Hall, with 85 present. This was one of the few occasions of the year when wives of the members join their husbands for a purely social evening. A short program of songs and monologues was presented, and after dinner dancing and cards were enjoyed.

Texas Section

At the annual meeting of the Texas Section, held in Beaumont, Tex., on November 8 and 9, 1935, several interesting talks were given. Among the speakers were Jean H. Knox, consultant and bridge engineer of Dallas, Tex.; E. A. Wood, associate consultant of the Texas Planning Board; W. B. Gregory, professor of experimental engineering at Tulane University; Merrill Bernard, consulting engineer of Crowley, La.; and Walter C. Carey, revetment engineer for the second district, New Orleans, La. Another interesting feature of the program was an inspection trip to the Texas Company's asphalt plant at Port Noches, Tex., and its canning plant at Port Arthur, Tex. The 1936 officers elected at this meeting were listed in the February issue of CIVIL ENGINEERING.

Toledo Section

On January 3 the Toledo Section held its annual meeting at the University Club. The speaker and guest of honor was J. Arthur MacLean, curator of art of the Toledo Museum of Art, who gave a fascinating account of archeological investigations of ancient buried cities. New officers were elected during the business meeting. These are as follows: Archibald Gardner, president; Clair B. Patterson, first vice-president; Harvey P. Jones, second vice-president; and Porter W. McDonnell, secretary-treasurer.

Virginia Section

The annual meeting of the Virginia Section was held at the Jefferson Hotel in Richmond on the afternoon and evening of January 23. During the business session the following officers were elected for 1936: W. D. Tyler, president; C. W. Ogden, Wilson T. Howe, and C. W. Johns, vice-presidents; and P. A. Rice, secretary-treasurer. After the business meeting the members were addressed by William A. Smith, administrator for the Works Progress Administration in Virginia, and by James A. Anderson, acting state director for the Federal Emergency Administration of Public Works. After dinner, which was served in the hotel, Herman Stabler, Director of the Society, spoke on Society affairs. He was followed by E. Randolph Williams, attorney, who discussed the constitution. There were approximately 50 present at the afternoon session, and about 75 at the dinner.

Student Chapter Notes

Rice Institute

A luncheon meeting of the Rice Institute Student Chapter, held on November 27, 1935, attracted an attendance of 28 members and 11 guests. At the conclusion of luncheon and a short business session, a talk was given by Walter P. Moore, structural engineer of Houston, Tex. Mr. Moore chose for his topic, "Engineering as a Profession."

Tufts College

On January 7 a meeting of the Tufts College Student Chapter was held. The feature of the occasion was the showing of motion pictures of the construction of the George Washington Bridge over the Hudson River at New York City. There were 27 present.

University of Arizona

A luncheon meeting of the University of Arizona Student Chapter was held at the El Presidio Hotel in Tucson, Ariz., on December 18, 1935, in honor of Walter E. Jessup, Field Secretary of the Society. In addition to Mr. Jessup, there were two other speakers—

SEAL OF UNIVERSITY OF ARIZONA STUDENT CHAPTER

Daniel E. Moran, consulting engineer of New York City, and William Dickinson, district engineer for the U. S. Geological Survey at Tucson. Mr. Jessup spoke on "A History of the Society, Its Accomplishments, and What It Means to the Young Engineer."

Appointments of Society Representatives

DANIEL W. MEAD, President Am. Soc. C.E., A. J. HAMMOND, Past-President Am. Soc. C.E., and CARLTON S. PROCTOR and JOHN C. HOYT, Members Am. Soc. C.E., and the Secretary have been appointed to represent the Society on the Construction League of the United States.

ROBERT RIDGWAY, Past-President Am. Soc. C.E., and THADDEUS MERRIMAN and FRANK E. WINSOR, Members Am. Soc. C.E., have been appointed by the President as a committee to undertake the preparation of a memoir of the late J. Waldo Smith, Hon. M. Am. Soc. C.E.

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for April

WORK is progressing in New York City's second underground vehicular crossing of the Hudson, the Midtown Hudson Tunnel, connecting the Borough of Manhattan with Weehawken, N.J. A similar tunnel is planned under the East River, giving access to the Borough of Queens and the 1939 World's Fair grounds, and the two tunnels are ultimately to be connected by a tube under 38th Street, Manhattan. The operation of this three-link system will present an intricate traffic problem, as there will be several junction points where traffic will enter as well as leave the tunnel. Anders Bull, M. Am. Soc. C.E., assistant engineer with the Board of Transportation of the City of New York, will explain in the April number of CIVIL ENGINEERING a proposed plan for regulating the traffic. Although under this plan the services of an experienced dispatcher will be required to control operation in general, the mechanism of the control system is automatic. It depends upon the transmission of electrical impulses from electro-mechanical car counters to special traffic indicating devices, permitting an additional car to enter the tunnel in Manhattan to take the place of each car which leaves, while signal controls keep each group moving at a definite speed by regulating the signal lights in the tunnels. Incoming and outgoing traffic will enter and leave the through lanes at points about 2,400 ft apart.

The ingenious construction and varied uses of a portable hydraulic laboratory form the subject of an article by Scott B. Lilly, M. Am. Soc. C.E., professor of civil engineering at Swarthmore College. This self-contained unit, which will permit water to be observed flowing through a variety of orifices and over a number of different types of weirs, is mounted on casters and is capable of being moved about from one classroom to another. In this way the laboratory is brought to the student, instead of the student to the laboratory.

An interesting foundation problem is also scheduled for presentation in April. In this, Ralph H. Chambers, M. Am. Soc. C.E., consulting engineer, describes the difficult work of underpinning the tower of New York's Trinity Church, a famous structure rebuilt in 1846. The tower foundations rest on a 12-ft stratum of coarse sand and gravel, but underlying this is a mixture of soft moist clay, fine sand, and finally quicksand extending 34 ft to rock. As the tower was imposing a pressure of as much as 6 tons per sq ft under one side, where it was slowly settling, it was necessary to provide underpinning of maximum capacity while removing only a very small part of the existing bearing area. It was decided to jack down to rock 17 cylindrical piers 4 ft in diameter, excavating during the process and afterward filling them with concrete. In view of the hazardous nature of the undertaking and the limited area available for the work, the means employed are of particular interest.

A number of other articles on a wide variety of topics are scheduled for the April issue of CIVIL ENGINEERING, which promises to be unusually interesting.

Illinois Society Elects Honorary Members

IN A CEREMONY celebrating its fiftieth anniversary, the Illinois Society of Engineers recently presented certificates of honorary membership to eight engineers who have rendered meritorious service to the engineering profession and to the Illinois Society of Engineers. Three members of the Society were among those thus honored. They are D. W. Mead, President of the Society, A. N. Talbot, Past-President of the Society, and E. E. R. Tratman, Assoc. M. Am. Soc. C.E.

Both Paul E. Green, president of the Illinois Society of Engineers, and George W. Pickels, retiring president, are Members of the Society. Harold E. Babbitt, secretary and treasurer of the organization, is also a Member of the Society.

New York Museum of Science and Industry in New Home

THE ANIMATED scientific models of the New York Museum of Science and Industry attracted some 8,000 visitors on February 12, 1936, the first day of their display in the Museum's new home in Rockefeller Center, New York, N.Y. The new quarters for this permanent exhibit—where people can "push buttons, make the wheels go round, and see for themselves how the machines of industry operate"—have been made possible by contributions from the Carnegie and Rockefeller foundations.

Of special appeal to those whose interests lie in the planning or construction of homes is the exhibit graphically demonstrating the development of the detached dwelling. A series of eleven models, built to the scale of one-quarter inch to the foot, shows the progression of the housing idea from the perched-on-stilts dwellings of river and jungle life thousands of years before Christ to the home of the modern well-to-do suburbanite. The models are elaborate and accurate, and include many details depicting the customs and occupations of the various periods.

There are many other exhibits, such as those featuring power production and transportation, that should be of great value in explaining and popularizing the work of the civil engineer.

Wise and Otherwise

THE FOLLOWING problem in literal long division has been submitted by Joseph S. Lambie, Assoc. M. Am. Soc. C.E., for use in Professor Abercrombie's column. Our readers are warned that the initial step is somewhat more difficult than in the problems published in January and February. The letters when arranged in order from 1 to 0 spell a word which is a bone of contention in concrete work.

```
X U R) I E A M S (R X
       I T D I
       -------
         D R E S
         D R E S
         -------
```

February's problem involved the solution of the following expression:

```
E M) V E C I R (O U T
       V L C
       -----
         L C I
         O E C
         -----
           U I R
           U M M
           -----
             U L
```

The obvious place to begin with this problem is in the first subtraction, where it will be seen that *C* subtracted from *C* gives *C*. Thus *C* represents zero. Again *M* multiplied by either *O* or *U* gives a number ending in zero. A little analysis shows that *M* is 5, and *O* and *U* represent 2 and 4, respectively. The key then follows very quickly:

```
V O L U M E T R I C
1 2 3 4 5 6 7 8 9 0
```

Suggestions for other problems, accompanied by solutions, should be addressed to the editor.

Engineering Institute of Canada Honors Society Members

THE FIFTIETH annual dinner of the Engineering Institute of Canada was held at the Royal Connaught Hotel in Hamilton, Ontario, on February 6, 1936. This gathering was the occasion for the presentation of several prizes and medals.

Among those honored was A. H. Harkness, M. Am. Soc. C.E., who was the recipient of the Sir John Kennedy Medal. E. A. Cleveland, M. Am. Soc. C.E., was elected president of the Institute for the coming year. Mr. Cleveland was chairman of the Local Committee on Arrangements at the time of the Society's Annual Convention in Vancouver, B.C., in July 1934.

Municipal Employees Have Salary Cuts Restored

OF OVER 250 cities in the United States having a population of 30,000 or more, 14 reported on March 1, 1935, that they had not reduced any salaries since 1930, and 110 reported restoring salary cuts either in full or in part. This information, of good import to hundreds of engineers in city service, appeared originally in a bulletin of the International City Managers' Association issued June 3, 1935. It was made available to CIVIL ENGINEERING by E. P. Goodrich, M. Am. Soc. C.E.

The cities that have kept the same salary schedule throughout the depression are Baltimore, Md.; Albany and Troy, N.Y.; Miami, Fla.; Reading and York, Pa.; Wilmington, Del.; Council Bluffs, Iowa; Newark and Springfield, Ohio; Oak Park, Ill.; Quincy, Mass.; San José and Santa Monica, Calif.

The 17 cities whose entire corps of employees are now getting their full-sized pay checks are Boston, Worcester, Brookline, and Lynn, Mass.; Philadelphia, Erie, and Allentown, Pa.; Fresno, Calif.; High Point, N.C.; St. Louis and St. Joseph, Mo.; Manchester, N.H.; Marion, Ohio; Pensacola, Fla.; Racine, Wis.; Denver, Colo.; and Savannah, Ga. Six other cities have made full restoration to specific groups of employees. Partial restoration of pay cuts ranging from 25 to 75 per cent of the original cuts has been made in 87 cities.

The purchasing power of the 1935 dollar, points out Clarence E. Ridley, executive director of the International City Managers' Association, is 20 per cent lower than that of the 1932 dollar, so that in cases where salary restorations have been made in full, employees are not getting a decided "raise" in pay. In cities which still have the cuts in effect or are contemplating further reductions, the figures for salaries and the cost of living are going in opposite directions.

Rudyard Kipling and the Engineer

IN EULOGIZING Rudyard Kipling, who died mourned by all on January 18, 1936, John Masefield, poet laureate of England, said "He was undoubtedly the best of the English imperial poets who helped to celebrate the achievements of the great reign of Queen Victoria. He was a story writer of genius, whose works have been a delight. ... To myself, who did not know his recent poetry, he is a Victorian poet whose best poems are not yet as well known as they should be. The great popularity of many of his ballads has tended to hide the merits of much work deeply felt and weightily told."

Kipling's writings indicate that he held the engineer first in importance in the army, with which many of his best-known ballads are concerned. But his pen also conferred enduring fame upon the engineer in civil life, and this is nowhere better illustrated than in "The Sons of Martha," which appears on the page of special interest in this issue.

Institution of Civil Engineers Issues New Periodical

ENGINEERS having occasion to consult the publications of the Institution of Civil Engineers will be interested in the *Journal*, which in November 1935 replaced the *Minutes of Proceedings* that have been issued by that organization for 98 years. The new publication will contain the papers that formerly appeared in the

THE HOME OF THE INSTITUTION OF CIVIL ENGINEERS, LONDON, ENGLAND

Minutes of Proceedings, as well as the "Selected Engineering Papers," which in the past have been published separately, and will also incorporate the reports of the Institution's research committee and announcements of meetings. It is therefore similar in function to the PROCEEDINGS of pre-CIVIL ENGINEERING days, which it resembles in form as well—although the new journal contains an extensive advertising section.

The Institution, which now numbers almost 11,000 members, associate members, and students, antedates the American Society of Civil Engineers by 34 years, having been founded in 1818. A royal charter of incorporation was granted the new organization ten years later. It was for the purpose of meeting the legal requirements of this charter that Thomas Tredgold prepared the now classic definition of civil engineering: "The art of directing the great sources of power in nature for the use and convenience of man."

Important events in the history of the Institution from these early days to the present are sketched briefly in the first issue of the *Journal*.

Maritime Association Asks Revision of Harbor Charts

A RESOLUTION urging the allotment of WPA and PWA funds for the modernization and revision of charts covering the harbors, bays, and connecting waterways of the American seaboard has been transmitted to authorities at Washington by the Maritime Association of the Port of New York.

It is pointed out that the hydrographic features of these waterways are subject to constant changes which necessitate periodic resurveys, and that the Coast and Geodetic Survey now has a large accumulation of field surveys ready for processing. Only the funds necessary for final preparation and publication are lacking. The Society's officers for some time have strongly supported the proposed project.

New Water Supply Papers Discuss Flood Data and Rainfall-Runoff Relations

AN ADDITION to the available basic information regarding flood characteristics of rivers in the United States is presented in a new report by the U. S. Geological Survey, Department of the Interior, as Water-Supply Paper 771, "Floods in the United States—Magnitude and Frequency." The Geological Survey prepared the publication in collaboration with the Water Planning Committee of the National Resources Board and its predecessor, which was the Mississippi Valley Committee.

By supplying a reliable compilation of records of flood occurrences for many rivers of the United States and a review of methods of analyzing flood data, the new report affords a background of knowledge and principles to promote better and sounder solutions of specific flood problems. It briefly reviews the best-known and also what appear to be the most promising of the more recently proposed methods of analyzing flood data. It attempts an impartial discussion of the limitations and the advantages and disadvantages of the various methods, and illustrates their application.

Essential flood data are listed for some 200 river-measurement stations selected with regard to geographic distribution, length and reliability of record, and comparability of physical conditions affecting the run-off habits of the drainage area throughout the period of record.

To the preparation of this report, valuable contributions were made by the Society's Committee on Flood Protection Data, authorized early in 1934 on request of the Mississippi Valley Committee. This committee continued to function as advisory to the Water Planning Committee of the National Resources Board when that organization took over and extended the compilation. It consists of Gerard H. Matthes, chairman; Frederick H. Fowler, Robert E. Horton, Ivan E. Houk, C. W. Kutz, Charles W. Sherman, and Daniel C. Walser. A progress report appeared in the February 1936 issue of PROCEEDINGS.

Studies of the relations between rainfall and runoff in the United States are reviewed in Water-Supply Paper 772, also recently issued by the Geological Survey. The objective of this report is primarily "the presentation of facts, generally elementary and basic, as disclosed by observed data or their simple analysis." Incidentally, "it was also the purpose of the study to disclose weaknesses and limitations in the application of the hydrologic and climatologic information and thus to be valuable in connection with the improvement or extension of fact-finding services engaged in collecting these basic data."

It is believed that the results "present much fundamental information, an understanding of which is essential to adequate long-time planning and execution of projects for the use and control of the water resources of the country."

New Shaking Table Reproduces Earthquakes

AT THE Ninety-Seventh Convention of the American Association for the Advancement of Science in St. Louis, on December 31, 1935, announcement was made in a paper presented before the seismology section of the completion of a remarkable new type of shaking machine which can reproduce earthquake motions direct from seismographic records. This machine was developed at the Massachusetts Institute of Technology, by Arthur C. Ruge, research associate in seismology in the Department of Civil and Sanitary Engineering, in consultation with Vannevar Bush, vice-president, and dean of engineering.

It is expected that the machine will be used principally for model testing in engineering seismological research. However, it has other possible applications, as in the field of mechanical vibration study. The general features of the machine and the principles used in the design are so different from those of other shaking tables that a brief description is necessary for an appreciation of its significance as a tool for research in engineering seismology.

Shaking tables which have been built in the past have been capable only of simple back-and-forth motions, which are admittedly a poor approximation of the motions of actual earthquakes. While some attempts have been made to obtain irregular motions by means of mechanical cams, the expense and awkwardness of such machines have so far proved an inhibition to their use as a practical laboratory device. There was thus need for a shaking machine possessing a great deal more flexibility than the existing ones. The new machine solves the problem in a very satisfactory manner. As the general principles involved are simple, the machine may be operated almost as easily as a radio receiving set.

A "shadowgraph" or optical cam is made from an earthquake record by cutting the record out along the irregular line which represents the quake. The top part is discarded, and the remaining shadowgraph is passed at a uniform speed before the electric "eye" of the machine. The white shadowgraph shown in the photograph was made from a record of the Long Beach, Calif., earthquake of 1933. An electric analyzing device coupled to the eye controls the machine in such a way that it is forced to follow the irregular line as the shadowgraph moves along. A beam of light moved by the machine enables the eye to see whether it is following properly along the shadowgraph.

In the photograph, a 5-ft model of a water tank, containing 40 lb of water, is mounted upon the shaking table. In the foreground, Mr. Ruge is adjusting the optical system and electric analyzing device. A pencil of light is the only connection between this device and the shaking table. The driving mechanism appears in the background.

The primary driving power of the machine is obtained from oil under pressure, working against a piston connected with the moving table. The electric analyzing device controls a valve which feeds the oil into the piston chamber. This valve is moved in exactly the same way that a radio receiver moves the diaphragm of a dynamic loud speaker, except that the force available for moving the valve can reach a maximum of nearly 50 lb, and so it can move very fast.

Although it can produce forces of over 2,000 lb when necessary, one of the interesting features of this shaking machine is that it produces only the amount of force needed to make it follow the shadowgraph properly. If a model is being shaken on the table, the machine's electric analyzing device automatically regulates the forces on the machine in such a way that the reaction or "back kick" of the model does not change its motion from the required path. This is another advantage that the earlier machines did not possess.

Provision has been made for the future addition of another drive at right angles to the first, so that motions of a more general character can be reproduced. For instance, some earthquake motions look like the figure 8, some like 0, and so on. It is also possible to add a vertical component to the machine if that becomes necessary in the course of future research. Up to the present, only a few quakes have been recorded near or in damaged areas. Fortunately, the U. S. Coast and Geodetic Survey is now equipped to record all strong earthquakes in the western part of the country, and information of great engineering value is being gathered.

At the meeting this paper was read for Mr. Ruge by N. H. Heck, M. Am. Soc. C.E., chief of the division of Terrestrial Magnetism and Seismology, U. S. Coast and Geodetic Survey, who is known for his untiring efforts to obtain practical engineering data relative to earthquakes.

NEW TYPE OF SHAKING TABLE DEVELOPED AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This Machine, by Duplicating in the Laboratory the Motions of Destructive Earthquakes, Makes It Possible to Study Directly the Effects on Various Engineering Structures

Brief Notes from Here and There

AMONG THOSE attending the Annual Meeting in January, certainly none could have been farther from home than Charles W. Turner, who remarked that it made little difference in mileage whether he went eastward or westward to get back. Mr. Turner is an engineer with the Department of Public Works of the Dominion of New Zealand. He is spending a year in this country studying earthquake-resistant construction and American methods of structural design.

* * * *

It is a pleasure to note the recent announcement that the impoundment above Boulder Dam has been named Lake Mead, in honor of Elwood Mead, M. Am. Soc. C.E., late Commissioner of Reclamation. Dr. Mead was a figure of outstanding importance in the development of the Boulder project, and died on the eve of its completion.

* * * *

When the earthquake of October 31, 1935, occurred at Helena, Mont., engineers of the U. S. Coast and Geodetic Survey succeeded in obtaining an unusual and extremely valuable accelerograph record. The epicenter of the quake was only 5 miles from Helena, and up to that time no complete data on a destructive shock in this country had ever been obtained so close to the seat of disturbance. Waves of short period dominated all three components. On one of the horizontal records a wave of 0.13-sec period reached an acceleration of 0.13 g, corresponding to a displacement of a little over 0.5 mm. The vertical accelerations were in general about two-thirds as great as the horizontal component values.

* * * *

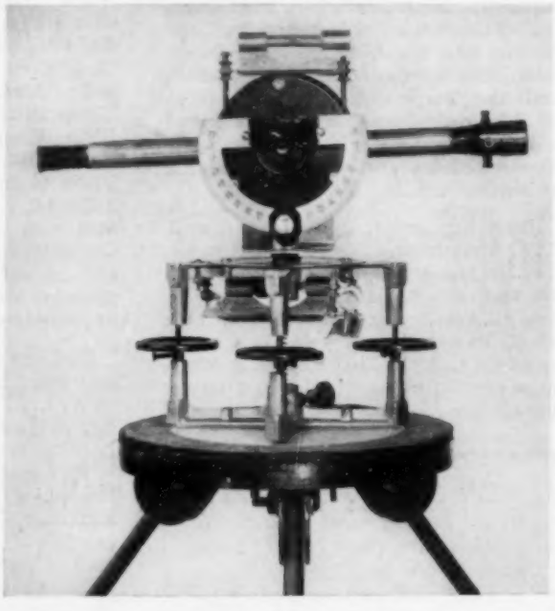
If night driving could be made as safe as daytime driving, highway fatalities could be cut almost in half. In New Jersey at least, it is reported, more fatalities occur at night than during the day, although the traffic is only about one-fourth as dense during the hours of darkness. Experiments with lighted highways have been encouraging and may go a long way toward solving the problem. For example, on a 4-mile stretch of lighted highway, night accidents per million vehicle miles were actually lower than the corresponding figure for daylight hours, while on nearby unlighted roads there were 3 to 4 times as many accidents per million vehicle miles at night as during the day.

Transit Built of Scrap Parts Wins $500 Prize

CONSTRUCTION of a stadia transit won for William R. Ahern the prized Yankee Ingenuity Scholarship of the Worcester Polytechnic Institute for 1935. In the eight years that this $500 scholarship has been offered, he is the fourth recipient who has had a project in the field of civil engineering.

Practically all parts of Ahern's transit were converted from things that had accumulated in his home workshop. The telescope was an old vacuum cleaner tube; the leveling screws were toy construction wheels; the telescope mounting, part of a radio condenser. He used ordinary protractors for horizontal and vertical circles, but provided no verniers. The tripod head was once the drumhead of a wool-spinning machine, and various other units were made from radio dials and other parts. He had to buy the telescope mounting block, three spirit levels, and a few nuts, bolts, and screws. The instrument can be used for rough work, though of course it lacks many of the refinements of a commercial transit.

The Yankee Ingenuity Scholarship was founded in 1928 by Dr. Henry J. Fuller of New York, a graduate and trustee of the Institute, for the purpose of stimulating and rewarding the ingenuity that New England boys are supposed by tradition to possess. It is awarded annually to the member of the entering class who best demonstrates "the accomplishment of a useful production with materials or methods of the most primitive character." This item has been furnished through the courtesy of Ray Linsley, secretary of the Student Chapter at Worcester Polytechnic Institute, and Prof. Herbert Taylor of the same school.



A VACUUM CLEANER, A RADIO, AND A WOOL-SPINNING MACHINE SUPPLIED PARTS FOR THIS INSTRUMENT

Consulting Engineers Elect Officers

EDWIN F. WENDT of Washington, D.C., has been elected president of the American Institute of Consulting Engineers for 1936. Gavin Hadden of New York, N.Y., is the vice-president, and Philip W. Henry, also of New York, continues as secretary and treasurer. All three are Members of the Society.

NEWS OF ENGINEERS

From Correspondence and Society Files

CARL D. FORSBECK, city engineer of Tacoma, Wash., was recently elected president of the Tacoma Engineers Club.

ANDREW W. SIMONDS has been transferred from the Boulder (Colo.) office of the U. S. Bureau of Reclamation to the Denver office of the Bureau.

WILLIAM H. CORREALE has recently been appointed deputy commissioner, Department of Water Supply, Gas and Electricity of New York City, in charge of the distribution of these utilities in the Borough of Queens. He was formerly with Parsons, Klapp, Brinckerhoff and Douglas, consulting engineers of New York City.

JOHN C. PARKER, formerly president of the Brooklyn (N.Y.) Edison Company, Inc., has been made vice-president of the Consolidated Gas Company of New York, with headquarters in New York City.

JAMES P. O'DONNELL is now a designer for the M. W. Kellogg Company, consulting engineers of New York, N.Y. He was previously a draftsman in the U. S. Coast and Geodetic Survey.

NICHOLLS W. BOWDEN is now principal hydraulic engineer for the Tennessee Valley Authority, with headquarters in Knoxville, Tenn. He was previously senior engineer in the U. S. Engineer Office at Pittsburgh, Pa.

PAUL F. ROSSELL has resigned as assistant engineer for the International Boundary Commission, with headquarters in San Benito, Tex., to accept an appointment as drainage engineer with the Resettlement Administration in Washington, D.C.

WILLIAM H. BATES has taken a position as assistant district supervisor in the U. S. Public Health Service at Statesboro, Ga. He was formerly an inspector in the Georgia State Highway Department.

CARLOS D. BULLOCK resigned as designer for the Central Nebraska Public Power and Irrigation District—Tri-County Project of the Public Works Administration at Hastings, Nebr., to accept a position as assistant structural engineer in the Engineering Design Division of the Tennessee Valley Authority. His headquarters are in Knoxville, Tenn.

H. C. WHITTLESEY, consulting structural engineer, announces his return to private practice. His office will temporarily be located at 525 North Normandie Avenue, Los Angeles, Calif. For the past two years he has been senior structural engineer for the California State Division of Architecture.

D. M. WHEELER, Life Member of the Society, has the distinction of being the sole survivor of the first class to be graduated from Massachusetts Institute of Technology. He is still actively engaged in the practice of his profession, being chief engineer of the Berkshire Street Railway Company, with headquarters in Pittsfield, Mass.

GEORGE H. HENDERSON, for many years chief engineer of the Rhode Island State Board of Public Roads, is now engaged with the Koppers Products Company, with the title of consulting engineer. His duties cover the New England district, with headquarters in Providence, R.I.

GEORGE E. SCHMIDT recently joined the staff of the Tennessee Valley Authority at Knoxville, Tenn., as principal engineering draftsman on aerial photographs. Formerly he was a photogrammetrist in the U. S. Forest Service at Greenwood, S.C.

JOHN WAIS, JR., has resigned as assistant chief engineer of the Reed Roller Bit Company of Oklahoma City, Okla., to become field engineer for the Pittsburgh Steel Company at Tulsa, Okla.

FRANK S. PALOCSAY has taken a position as chief of topographic party with the Central Nebraska Public Power and Irrigation District, Tri-County Project, in the Hastings (Nebr.) district, with headquarters in Hastings.

ROBERT A. VOELKER is now with the Francis Engineering Company of Saginaw, Mich.

R. J. MCMAHON, formerly technical assistant in the Texas State Reclamation Department, was recently appointed state reclamation engineer. He will succeed ASHLEY G. CLASSEN who resigned to become superintendent of the El Paso Water Department.

F. A. TORKELSON has been appointed chief engineer for PWA projects in the Virgin Islands. He was previously city engineer of Wauwatosa, Wis.

MILES E. CLARK is now chief engineer of the Seattle and Rainier Valley Railway, with headquarters in Seattle, Wash.

ALLEN S. HACKETT was recently elected president of the Louisiana Engineering Society succeeding EDWARD S. BRES, retiring president.

KARMY K. MURDICHIAN is now senior designer in the Department of Parks, City of New York. Previously he was a draftsman for Gibbs and Hill of the same city. Mr. Murdichian is also an instructor in engineering in the evening division of the College of Engineering of New York University.

JOHN A. SPEECE has resigned from the Washington State Highway Department to accept a position as field engineer at the Tacoma (Wash.) plant of the American Smelting and Refining Company.

GEORGE L. REED is now in the Inspection Division of the Public Works Administration, with headquarters in Washington, D.C. He was formerly regional structural engineer for the Portland Cement Association in Atlanta, Ga.

ROBERT LINTON has been elected chairman of the Southern California Section of the American Institute of Mining Engineers. He was also recently elected director and chairman of the mining committee of the Los Angeles Chamber of Commerce.

CHARLES S. SHAUGHNESSY and SETH VAN LOAN, together with a third Philadelphia engineer, were awarded medals for metitorious work in the public service by the Philadelphia Chapter of the American Society of Municipal Engineers at its annual dinner held January 23, 1936. Mr. Shaughnessy is president of the Philadelphia Section of the Society.

SETH G. HESS was recently appointed assistant state engineer-inspector of New York for the Public Works Administration. Formerly he was resident engineer-inspector for the Federal Emergency Adminstration of Public Works.

DECEASED

WILFRED KEEFER BARNARD (M. '13) a member of the consulting engineering firm of Quinton, Code and Hill-Leeds and Barnard of Los Angeles, Calif., died in Pasadena on January 22, 1936, at the age of 57. After graduating from Yale University with the civil engineering degree, he became a member of the engineering staff of the Pennsylvania Railroad. Later he was with the Los Angeles and Salt Lake Railroad (now the Union Pacific), and the Pacific Electric Railway. In 1912 he retired from railroad work and a little later entered private practice. He lived in California from 1906 until the time of his death.

JOHN BIDDLE (M. '94) Major General, U. S. Army (retired) died at San Antonio, Tex., on January 18, 1936, at the age of 76. He was born in Detroit, Mich., on February 2, 1859. After graduating from the U. S. Military Academy in 1881, he entered the Corps of Engineers, U. S. Army, as a second lieutenant. He saw service during the Spanish American War and later in Puerto Rico and the Philippines. From 1907 until the outbreak of the World War he supervised river and harbor work at San Francisco, Savannah, Baltimore, and other American cities. In 1916 President Wilson appointed him superintendent of the U. S. Military Academy. Less than a year later he was assigned to organize and command the 6th U. S. Engineers, a special regiment which was among the first troops sent abroad. During his 35 years of service up to this time he had risen through the various grades to the rank of major-general. In 1920 he retired from the Army.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

HORACE CULPEPER (Assoc. M. '17) a member of the firm of Culpeper and Flagg of Houston, Tex., died in that city on January 17, 1936. He was born in Houston on August 22, 1883. A specialist in railroads, sanitary engineering, and land surveys, he devoted most of his career to public service projects in his native state. He was with the Houston Light and Power Company from 1917 to 1925. For seven years he served as city engineer of Magnolia Park, Tex., in which capacity he was instrumental in the construction of sanitary sewer and gas main systems.

FREDERICK CALVIN DAVIS (M. '27) structural engineer for Gladding, McBean and Company of San Francisco, Calif., died on January 25, 1936, at the age of 73. He was born in Lansing, Mich., and graduated from Michigan State College in 1886, with the degree of B.S. C.E. In 1890 he became structural engineer for Gladding, McBean and Company of San Francisco, Calif. With the exception of four years as manager of the Pacific Clay Products Publicity Bureau, he remained there for the rest of his life, designing the structural features of many buildings here and abroad. From 1893 to 1901 he was also city engineer of Lincoln, Calif.

BENJAMIN CURTIS DONHAM (M. '08) a retired civil engineer and president of the Glen Ridge (N.J.) Board of Education, died at his home in Glen Ridge, on January 14, 1936, at the age of 63. He was born in Rockland, Mass., and graduated from Massachusetts Institute of Technology in 1895. From 1900 to 1908 he was with the Colburn Bostwick Company on the installation of water works at Seoul, Corea. Following this engagement, he was affiliated with the J. G. White Engineering Corporation of New York for a short period. Later he formed the consulting engineering firm of B. C. Donham. In 1933 he retired from active practice.

HOWARD NIXON ELMER (M. '86) general agent for Siebe, Gorman and Company, Ltd., of Chicago, Ill., died in that city on January 13, 1936. He was born in Bridgeton, N.J., on April 27, 1856, and in 1877 graduated as a civil engineer from Rensselaer Polytechnic Institute. After a number of years devoted to the general practice of civil engineering he joined the staff of Siebe, Gorman and Company in 1892. He was instrumental in organizing the Chicago Engineers' Club and served as its first president. In 1932 he was made an honorary member of the club.

HOLLIS GODFREY (M. '14) consulting engineer and educator, died at Duxbury, Mass., January 17, 1936, at the age of 61. He graduated from Tufts College in 1895. Mr. Godfrey later studied at Harvard University, Massachusetts Institute of Technology, and other colleges in this country and England. He held doctorates in law and science. From 1906 to 1910 he was head of the department of science of the Boston School of Practical Arts, and for the next seven years was consulting engineer to the Iowa Survey, making a study of health conditions in Philadelphia, Pa., and Atlantic City, N.J. In his later years he was a frequent contributor to technical and other magazines. In 1913 Mr. Godfrey was elected president of Drexel Institute in Philadelphia.

FREDERICK BILLINGS HOWARD (M. '78) consulting engineer of Detroit, Mich., died in that city on May 29, 1934, at the age of 88. After graduating from the engineering school of Union College in 1867, he went into surveying work. From 1871 to 1873 he was in charge of construction of the Cayuga Lake Railroad and of extensions and branches to the Detroit and Bay City Railroad. As chief engineer of the Grosse Ile Bridge Company of Michigan, Mr. Howard was in charge of bridge-building projects in and about Detroit. During the War he was government inspector on airplane production, and beginning in 1922 served as general assistant engineer on the construction of the Ambassador Bridge across the Detroit River. For a number of years he had a consulting engineering practice in Detroit.

CLIFFORD SHERRON MACCALLA (M. '10) vice-president and division manager of the Ohio Edison Company of Youngstown, Ohio, died in that city on February 4, 1936, at the age of 59. He was born in Wallingford, Pa., on March 31, 1876, and graduated from Lehigh University in 1896. He served with electrical engineering organizations for a considerable time, including fifteen years with the Washington Water Power Company and seven years with the Pennsylvania-Ohio Power and Light Company. In 1930 he joined the staff of the Ohio Edison Company, where he remained until his death.

LUDLOW LAWRENCE MELIUS (Assoc. M. '05) died at Warren, Conn., on January 14, 1936, at the age of 61. After receiving an engineering degree from Union College in 1896, he was employed for two years on engineering and construction work with the Tivoli Hollow Railroad. For a number of years he was engaged on dam and road engineering work and at one time had charge of the construction of aqueducts on the Champlain Canal. After his retirement from engineering 20 years ago, he made his home in Connecticut. In 1931 and 1933 he served as a member of the Connecticut state legislature.

ELWOOD MEAD (M. '93) U. S. Commissioner of Reclamation, died in Washington, D.C., on January 26, 1936, at the age of 78. He was born at Patriot, Ind., on January 16, 1858, and graduated from Purdue University in 1882 with the bachelor of science degree. Beginning in 1888, he was for eleven years territorial engineer for Wyoming, and later headed the irrigation and drainage investigations of the U. S. Department of Agriculture. From 1898 to 1907 Dr. Mead was professor of irrigation practices at the University of California, leaving the latter institution to become chairman of the State Rivers and Water Supply Commission of Victoria, Australia. In 1915 he returned to California to resume his professorship. In 1924 President Coolidge appointed him chief of the U. S. Bureau of Reclamation, in which capacity he supervised irrigation works involving the construction of many of the largest dams in the United States. Dr. Mead served on commissions in Cuba and Haiti and acted as adviser on water and irrigation problems to the governments of New South Wales, Canada, Hawaii, Java, and Mexico.

ELWOOD MEAD

ROBERT BROOKS MORSE (M. '14) chief engineer of the Washington Suburban Sanitary District, died at the age of 55 in Washington, D.C., on February 1, 1936. He was born in Montpelier, Vt., on September 13, 1880, and graduated from Johns Hopkins University in 1901. In 1904 he received the B.S. degree from Massachusetts Institute of Technology. His engineering career included experience with the Baltimore Sewerage Commission, the Metropolitan Sewerage Commission of New York, and the Maryland State Department of Health. For the latter organization he was in full charge of supervising state water supply and sewerage systems. From 1918 until his death Mr. Morse was chief engineer for the Washington Suburban Sanitary District, and from 1910 until his death he was a consulting civil and sanitary engineer.

GEORGE PAUL O'CONNELL (Assoc. M. '10) vice-president of Daniel O'Connell's Sons, Inc., general contractors of Holyoke, Mass., died January 3, 1936, at the age of 56. He was born in Holyoke, Mass., and in 1902 graduated from Massachusetts Institute of Technology, with the B.S. degree. His early engineering experience included work as an assistant engineer on the construction of water pipe lines for the Passaic Water Company of Paterson, N.J. From 1904 to 1906 Mr. O'Connell served as transitman for the Aqueduct Commission of New York City and, thereafter, for a number of years as assistant engineer for the New York City Board of Water Supply, engaged on the survey and construction of Ashokan Reservoir. Later he became an official of the contracting firm of Daniel O'Connell's Sons, Inc.

FRANK HURD PICKETT (Assoc. M. '17) sales engineer for the R. Hardesty Manufacturing Company of Denver, Colo., died in July 1935, at the age of 50. He was born in Toledo, Ohio, and took engineering courses at Purdue University and the University of Colorado. His experience included surveying, irrigation, and construction work. From 1913 to 1916 he was employed by J. and F. Kelly of Brooklyn, N.Y., in charge of the design and construction of waterfront protection structures at Sea Gate, Brighton Beach, and Rockaway Beach, and of numerous small piers and bridges. In 1935, after a number of years with the Burnham Manufacturing Company of Pocatello, Idaho, he joined the staff of the R. Hardesty Manufacturing Company.

JACOB BOMBERGER ROHRER (M. '07) retired civil engineer and contractor, died in Brooklyn, N.Y., on February 7, 1936, at the age of 78. He was born in Lancaster, Pa., and graduated in 1876 from Polytechnic College of Pennsylvania at Philadelphia. Although much of his engineering work was accomplished in New York City, he constructed many important engineering works in other places. These included street car lines in Honolulu, the Monadnock Building in San Francisco (which remained intact through the earthquake and fire of 1906), and a part of the Chicago drainage canal. Until his retirement ten years ago he had been for many years associated with the contracting firm of Charles Meads and Company in New York City.

DOUGLAS WILLIAM ROSS (M. '99) examining engineer for the Public Works Administration in Washington, D.C., died in Berkeley, Calif., on June 22, 1935. He was born in Iona, Ontario, on December 7, 1865, and came to the United States in 1886. Thereafter his career was linked with the development of the West where he was employed on various pioneering railroad, surveying, irrigation, and water power projects. For a time he was supervising engineer for the U. S. Reclamation Service at Boise, Idaho.

HENRY BEDINGER RUST (M. '03) chairman of the board of the Koppers Company of Pittsburgh, Pa., died in that city on January 17, 1936, at the age of 63. He was born near Leesburg, Va., in December 1872. After 11 years' experience with the Pittsburgh Department of Public Works, he went into business in 1903 as vice-president and general manager of the Rust Boiler Company. From 1908 to 1915 he

was special representative of the Babcock and Wilcox Company, boiler manufacturers of New York. In 1915 he founded and became president of the Koppers Company, which grew under his guidance to become a great holding company with interests in coal, gas, and electricity production and rail and steamship transportation. He remained president until 1933 when he became chairman of the board.

EDWARD JOHN SCHNEIDER (M. '09) contracting manager of the bridge and structural department of the Columbia Steel Company, died in Berkeley, Calif., on January 25, 1936, at the age of 60. In 1900 he graduated from the University of Illinois, and in 1907 went to San Francisco to become contracting manager, first for the American Bridge Company; later for the U. S. Steel Products Company; and finally for the Columbia Steel Company. Among the more important bridges on which he was employed are the Carquinez Straits Bridge, the Southern Pacific Railway bridge at Suisun, Calif., and the state highway bridge now being constructed between San Francisco and Oakland.

HENRY CLEMENT SMITH (M. '01) division engineer of the Philadelphia Division of the Reading Company, died on January 11, 1936. He was born in 1860 and graduated from the University of Pennsylvania in 1881. His career centered chiefly in railroad work. Among the lines with which he was connected were the Little Rock and Fort Smith Railroad, and the Philadelphia, Wilmington and Baltimore Railroad. His service with the Reading Company extended for a period of over thirty years.

REENEN JACOB VAN REENEN (Assoc. M. '11) died in Pretoria, Union of South Africa, on October 19, 1935, at the age of 51. He was born at Calvinia, Cape Province, South Africa. In 1902 he received the B.A. degree from the University of Cape of Good Hope, and in 1906 that of C.E. from Lehigh University at Bethlehem, Pa. While he was in the United States he was employed by the Tri-State Land Company of Nebraska on canal construction. In December 1907, after a study of irrigation centers in the western states, he returned to South Africa and entered private practice as an irrigation engineer. Later he was employed on work for the irrigation department of Cape Colony.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From January 10 to February 9, 1936, Inclusive

ADDITIONS TO MEMBERSHIP

AHLF, AUGUST LOUIS (Jun. '36), Field Clerk, Inspection Div., PWA, 379 East 2d North St., Logan, Utah.

ARENA, ANGELO THOMAS (Jun. '36), 109 Beech St., Yonkers, N.Y.

ASHTON, NED LOWELL (Assoc. M. '36), Chf. Designer, Kansas City Office, Ash-Howard-Needles & Tammen, 1012 Baltimore Ave., Kansas City, Mo.

BEPLAT, JAMES AUDEMARD (Jun. '36), 38-33 One hundred and fiftieth St., Flushing, N.Y.

BARRASSO, ANTHONY JOHN (Jun. '36), Constr. Foreman, State Dept. of Highways (Res., 310 South 6th St.), Reading, Pa.

BENAS, BENJAMIN (Assoc. M. '35), San. Eng. Designer, Eng. Dept., City of San Francisco, Room 367, City Hall, San Francisco, Calif.

BENJES, HENRY HERMAN (Jun. '35), 921 West 42d St., Kansas City, Mo.

BERKOWITZ, SIDNEY ADRIAN (Jun. '35), U. S. Marine Hospital, Key West, Fla.

BISHOP, AVERY ALVIN (Jun. '35), Box 247, Logan, Utah.

BOSWORTH, LEWIS ALBA (Jun. '35), Bridge Insp., State Highway Dept., Box 454, Chelsea, Mich.

BRAY, OSCAR SIMON (Assoc. M. '35), Project Supt., U. S. Dept. of the Interior, National Park Service, Cold Spring, N.Y.

BUZO, ZIHNI JUSUF (Jun. '35), Seksioni Antimalarik, Tirana, Albania.

CAHOON, JAMES WAYNE (Jun. '35), Care, U. S. Bureau of Reclamation, St. George, Utah.

CARTER, VERNON LEE (Jun. '36), Rodman, State Highway Comm., Box 425, Clay Center, Kans.

CHISARI, MARIO VINCENT (Jun. '35), 2340 Belmont Ave., New York, N.Y.

COCHRANE, HENRY PARK (Assoc. M. '35), Eng. Draftsman, U. S. Navy Dept., Puget Sound Navy Yard (Res., 43 South Court Apartments), Bremerton, Wash.

CONWELL, WILLIAM ANTHONY (Assoc. M. '36), Designer, Allegheny County Authority (Res., 221 Ulysses St.), Pittsburgh, Pa.

CORDON, WILLIAM ALFRED (Jun. '35), Island Park, Idaho.

CORNELIUS, WILLIAM PASCAL (Jun. '36), Instrumentman, State Highway Dept., 706 South Walnut St., Clarksville, Tex.

DEVORE, RODNEY WALTER (Jun. '35), 100 Cochran Rd., South Hills Station, Pittsburgh, Pa.

DONALDSON, HOWARD WILLIAM (Jun. '35), 503 West Colden St., Polo, Ill.

DOWNE, CHARLES EDWARD (Jun. '35), Draftsman, U.S. Engr. Office, Lock Design Div. (Res., 1620 Sixteenth Ave., South), Nashville, Tenn.

ERSKINE, JAMES ANCONA (Jun. '35), 124 Marstellar St., West Lafayette, Ind.

FARRELL, GEORGE WESLEY (Assoc. M. '36), City Engr., City Hall, Hannibal, Mo.

FINK, WILLIAM KENNETH (Jun. '35), Crows Landing, Calif.

GAMBRELL, JAMES WYATT (Jun. '35), Eng. Aide, SCS, Anderson (Res., 402 Brown Ave., Belton), S.C.

GORDON, RICHARD THOMAS (Assoc. M. '35), Draftsman, Office of Chf. Engr., Board of Estimate and Apportionment, City of New York, 2700 Municipal Bldg., New York, N.Y.

GRASIER, FREDERICK ARDEN (Jun. '35), 159 Hillside Ave, Klamath Falls, Ore.

HAM, CAVIS BEECHER (Jun. '35), Rodman, Moffat Water Tunnel Project (Res., 1824 Race St.), Denver, Colo.

HARDER, BERNARD SAMUEL (Jun. '35), Engr., Los Angeles County Sanitation Dists., 1837 Pine Street, San Gabriel, Calif.

HATTRUP, RICHARD ADOLPH (Jun. '35), Junior Engr., Eng. Dept., Standard Oil Co. of California, 225 Bush St., Room 1218, San Francisco (Res., 2235 Hearst Ave., Berkeley), Calif.

HAYES, JOHN MARION (Jun. '36), Junior Eng. Draftsman, TVA, Knoxville (Res., Bean Station), Tenn.

HELMICH, DANIEL ANDREW (Assoc. M. '36), Asst. Engr., Jefferson County Highway Dept., Room 216 Court House, Birmingham, Ala.

JENSEN, EARL SAMUEL (Jun. '35), Care, U. S. Bureau of Reclamation, Provo, Utah.

JOHNSTON, ROBERT COSSIN (Jun. '36), 106 East 236th St., New York, N.Y.

JONES, PAUL AGNEW (M. '36), Engr., U. S. Bureau of Reclamation, 600 First Ave., Yuma, Ariz.

KEAVENY, FELIX JAMES (Jun. '35), Computer, U. S. Coast and Geodetic Survey; 162 Hunter Ave., Yonkers, N.Y.

KENNEDY, JOSEPH MICHAEL (Jun. '35), 3413 Cannon Pl., New York, N.Y.

KENNY, JAMES STEPHEN (Assoc. M. '36), Asst. Engr., Floyd Bennett Airport, Dept. of Docks, City of New York; 7256 Manse St., Forest Hills, N.Y.

KETCHUM, MILO CLEMENT (Jun. '35), 525 Prospect Boulevard, Pasadena, Calif.

KNAPP, ROBERT TALBOT (M. '35), Cons. Engr., Los Angeles County Flood Control Dist.; Cons. Engr., Met. Water Dist. of Southern California; Asst. Prof., Mech. Eng., California Inst. of Technology, Pasadena, Calif.

KROUP, BENJAMIN ADAM (Jun. '35), 19 John St., Amsterdam, N.Y.

TOTAL MEMBERSHIP AS OF FEBRUARY 9, 1936	
Members	5,713
Associate Members	6,147
Corporate Members	11,860
Honorary Members	21
Juniors	3,169
Affiliates	94
Fellows	2
Total	15,146

LAGANI, FRANK SALVATORE (Jun. '35), 337 East 146th St., New York, N.Y.

LEE, FRED (Jun. '35), 804 West 29th St., Austin, Tex.

LIENSCHER, ARTHUR FRANK (Jun. '36), Insp. of Constr., Outer Harbor Terminal, Port of Oakland (Res., 979 Grosvenor Pl.), Oakland, Calif.

LUCE, WILLIAM FALCONER (Jun. '35), Care, U. S. Forest Service, Childress, Tex.

MARTIN, EARL HOWARD (Jun. '35), 434 Spruce St., Apartment 3, Morgantown, W.Va.

MEMORY, DUNCAN THOMAS (Assoc. M. '36), Office Engr. (Executive Asst.), TVA, Tazewell, Tenn.

MILLER, RAYMOND VERNON (M. '36), Lt.-Commander, C.E.C., U.S.N., Asst. Public Works Officer, New York Navy Yard, House M, Navy Yard, Brooklyn, N.Y.

OAKEY, JOHN ARTHUR (Assoc. M. '36), Instr., Civ. Eng. Dept., Columbia Univ., New York, N.Y.

OFFICER, ROBERT MAYFIELD (Jun. '35), Sanitarian, Santa Fé County; 304 South 5th St., Raton, N.Mex.

OUTLAND, GILBERT WAYNE (Assoc. M. '35), Designer, Los Angeles County Flood Control Dist., Los Angeles (Res., 1650 North Holliston Ave., Pasadena), Calif.

POWELL, FRED JACKSON (Assoc. M. '35), Partner with A. U. Whitson (Res., 42-23 One Hundred and Sixty-Fifth St.), Flushing, N.Y.

QUILTY, THOMAS PATRICK (Jun. '36), 601 West 163d St., New York, N.Y.

RIEPE, GERALD EUGENE (Jun. '35), 1918 West 47th St. Terrace, Kansas City, Kans.

RINGEL, PHILIP (Jun. '35), Junior Draftsman, B.P.M. (CWA), New York (Res., 565 Elton St., Brooklyn), N.Y.

RINNE, CLARENCE EMIL (Jun. '35), Junior Engr., Standard Oil Co. of California, San Francisco (Res., 1316 Albina Ave., Berkeley), Calif.

ROLETTE, ROMEO (Jun. '35), 2052 West 7th St., Brooklyn, N.Y.

ROUSE, HUNTER (Assoc. M. '36), California Inst. of Technology, Pasadena, Calif.

RUSSELL, HOWARD ARTHUR (Jun. '35), Civ. Engr., Soulé Steel Co., San Francisco (Res., 2400 Durant Ave., Berkeley), Calif.

SAMPPALA, LEONARD JOHANN (Jun. '35), Crystal Falls, Mich.

SARANIERO, EMIL JOSEPH (Jun. '35), Eng. Draftsman, Mech., Bureau of Ordnance, Navy Dept., Navy Yard (Res., 31 St. Marks Ave.), Brooklyn, N.Y.

SCHLESINGER, MAX (Jun. '35), Junior Highway Engr., Div. of Highways, 307 West Main St., Carbondale, Ill.

SEEGER, WILLIAM ROBERT (Jun. '35), 2267 Thirty-Fifth Ave., San Francisco, Calif.

SEELEY, HOWARD WILSON, JR. (Jun. '35), Asst., Eng. Corps, Div. Engr's Office, P.R.R. (Res., 822 Plum St.), Erie, Pa.

SNOW, DEWITT MILLS (Jun. '35), Coulee Dam, Wash.

SOLOMON, CHARLES EDWARD (Jun. '35), Junior Highway Engr., Grade VIII, State Div. of Highways, Dist. 6, 2d and Ash Sts. (Res., 1501 Lowell Ave.), Springfield, Ill.

THOMPSON, JESSE NEILS (Jun. '35), 3803½ Duval, Austin, Tex.

THORNTON, CHARLES VICTOR (Jun. '35), Steel Detailer, Truscon Steel Co., 222 Outlook Ave., Youngstown, Ohio.

VAN ATTA, FRED FOSTER (Jun. '36), Under Eng. Aide, TVA, 410 City National Bank Bldg., Paducah, Ky.

VAN CAMP, CHANNING POLLOCK (Jun. '35), Junior Topographic Engr., U. S. Geological Survey, 219 East Center St., Pomona, Calif.

VAN HORN, ROBERT BOWMAN (M. '36), Associate Prof., Civ. Eng., Univ. of Washington (Res., 3847 Forty-Third Ave., N.E.), Seattle, Wash.

VAUGHAN, EVAN WILLIAM (Jun. '35), Eng. Aide, Gen. Eng. Div., TVA, Box 277, Norris, Tenn.

VENARD, JOHN VICTOR (Jun. '35), Concrete Insp., Grade A, Constr. Dept., State Highway Comm., 1001 Ave. C, Dodge City, Kans.

WHEELER, WALTER MCCLAVE (Assoc. M. '36), City Engr. (Res., 213 South Walnut St.), Grand Island, Nebr.

WILSON, GUTHLAC (Assoc. M. '35), Care, Braithwaite & Co. (India) Ltd., Box 427, Calcutta, India.

YUKTASEVI VIVATANA, LUANG (Assoc. M. '35), Constr. Engr., Royal State Rys. of Siam, Bangkok, Siam.

ZEHETNER, FRANCIS CHARLES (Assoc. M. '36), Prof. and Head of Dept., Eng. Mechanics, Manhattan Coll., New York, N.Y.

MEMBERSHIP TRANSFERS

ANCKAITIS, VICTOR WILLIAM (Jun. '28; Assoc. M. '36), Boro Engr. of Wilson Boro; Asst. Supt. of Highways, Northampton County, State Dept. of Highways (Res., 1929 Ferry St.), Easton, Pa.

BIRMAN, HERMAN (Jun. '26; Assoc. M. '35), Supt. of Constr., Works Div., Dept. of Parks (Res., 542 Rosedale Ave.), New York, N.Y.

BROWDER, EDWARD MARION, JR. (Jun. '27; Assoc. M. '35), Structural Draftsman, Section of Office Engr., Dept. of Operation and Maintenance, The Panama Canal, Box 67, Balboa Heights, Canal Zone.

COX, GEORGE FRANCIS (Jun. '26; Assoc. M. '35), Junior Asst. Engr., Grade 2, State Div. of Highways, Poughkeepsie (Res., 98 Rosedale Rd., Tuckahoe), N.Y.

DUNSTAN, GILBERT HALL (Jun. '27; Assoc. M. '35), Asst. Prof., Gen. Eng., Univ. of Southern California, Los Angeles, Calif.

IVANCICH, PAUL NICHOLAS (Jun. '27; Assoc. M. '36), 710 Hawthorne Ave., Houston, Tex.

LANE, DWIGHT ARNOLD (Assoc. M. '24; M. '35), Asst. Engr., Bureau of Water Works and Supply, City of Los Angeles, Box 240, Arcade Annex, Los Angeles, Calif.

LARSON, ROY EDWIN (Jun. '26; Assoc. M. '35), Estimator, James Stewart & Co., Inc., 230 Park Ave., New York, N.Y.

LEWIS, WILLIAM WHITFIELD (Jun. '34; Assoc. M. '36), Instr., Civ. Eng., Duke Univ., Box 294, College Station, Durham, N.C.

LOEHNINGER, FERDINAND TRUESDELL (Assoc. M. '25; M. '35), Cons. Engr., 22 East 40th St., New York, N.Y.

MOTTA, ARNALDO ALVES DA (Assoc. M. '31; M. '35), Mgr.-Director, Cia Carbonifera de Ribeirão Nova; Civ. Engr., Box 1759, São Paulo, Brazil.

NIEMEN, ELMER JACOB (Jun. '30; Assoc. M. '36), Associate Engr., Coulee Dam. U. S. Bureau of Reclamation, Box 68, Coulee Dam, Wash.

RENZ, CARL FRED (Jun. '24; Assoc. M. '35), Asst. Testing Engr., Los Angeles County Flood Control Dist., Los Angeles (Res., 217 South 6th St., Alhambra), Calif.

SEELY, GEORGE HERMAN (Jun. '27; Assoc. M. '36), Engr., Lago Petroleum Corporation, Apartado 172, Maracaibo, Venezuela.

SHOCKLEY, DALE ROBERT (Jun. '29; Assoc. M. '35), Asst. Agri. Engr., SCS, Dept. of Agriculture, Fort Wingate, N.Mex.

SMITH, WILLIE WADE (Jun. '31; Assoc. M. '35), Asst. Structural Engr., Bureau of Yards and Docks, U. S. Navy Dept., Washington, D.C. (Res., 3008 Second Rd., North, Clarendon, Va.).

SNYDER, MORRIS KAY (Assoc. M. '27; M. '35), Prof., San Eng., and Head, Dept. of Civ. Eng., State Coll. of Washington (Res., 305 Columbia Ave.), Pullman, Wash.

SORENSEN, ALTON HARRY (Jun. '27; Assoc. M. '35), Engr., Caldwell & Richards (Res., 929 California Ave.), Salt Lake City, Utah.

SOROKA, MARY OLGA (Jun. '27; Assoc. M. '36), Engr., Julian P. Friez & Sons, Inc., 4 North Central Ave., Baltimore, Md.

STRUCK, HENRY EDWARD (Jun. '26; Assoc. M. '35), Asst. Highway Engr., State Div. of Highways, Bridge Office (Res., 1901 Dial Court), Springfield, Ill.

VETTER, CARP PETER PEDERSEN (Assoc. M. '27; M. '35), Engr., U. S. Bureau of Reclamation, Denver, Colo.

WEGWEISER, JACOB (Jun. '30; Assoc. M. '35), Asst. Engr., Mason & Hanger Co., Inc., 481 Eleventh Ave., New York, N.Y.

REINSTATEMENTS

BARNES, JAMES NEWTON, Jun., reinstated Feb. 4, 1936.

BERNHANG, SAMUEL, Assoc. M., reinstated Feb. 3, 1936.

CAPRONI, LEO FRANCIS, Affiliate, reinstated Jan. 22, 1936.

DAVIS, CHARLES MCRAE, Assoc. M., reinstated Jan. 20, 1936.

DOERR, HAROLD FRANCIS, Assoc. M., reinstated Feb. 6, 1936.

HIGGINS, THOMAS WILLIAM, Assoc. M., reinstated Jan. 28, 1936.

JOHNSON, TOM ROYSE, Jun., reinstated Jan. 27, 1936.

MCKENZIE, ALEXANDER MAXWELL, Assoc. M., reinstated Jan. 30, 1936.

SNYDER, LAWRENCE KING, Jun., reinstated Jan. 30, 1936.

VOKAC, ROLAND, Assoc. M., reinstated Jan. 22, 1936.

WOODBURY, WILLIAM NICOLL, M., reinstated Jan. 13, 1936.

YOUNG, ARRIGO MAZZUCATO, M., reinstated Jan. 20, 1936.

RESIGNATIONS

CROSETTO, EDWARD FRANCIS, Assoc. M., resigned Jan. 24, 1936.

DACK, BRUCE M., Jun., resigned Jan. 20, 1936.

GOODRICH, GILMAN GRANGER, Jun., resigned Jan. 14, 1936.

HETZLER, PAUL GEORGE, Jun., resigned Jan. 20, 1936.

JACKSON, CHARLES THOMAS, Assoc. M., resigned Jan. 13, 1936.

LANGMAN, RICHARD SHERRARD, Jun., resigned Jan. 20, 1936.

MARTENS, LEROY PETER, Jun., resigned Jan. 13, 1936.

OWEN, ERNEST VALENTINE, Assoc. M., resigned Jan. 14, 1936.

ROSS, ALBERT WARD, JR., Jun., resigned Jan. 20, 1936.

WATSTEIN, DAVID, Jun., resigned Jan. 8, 1936.

WITMER, EARL JOHN, Jun., resigned Jan. 14, 1936

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

March 1, 1936 NUMBER 3

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

AKANS, JAMES ERNEST, Tate Springs, Tenn. (Age 27.) Senior Eng. Aide, Party Chf. and Concrete Inspector, U. S. War Dept., Chattanooga, Tenn. Refers to J. W. Bradner, Jr., N. W. Dougherty, E. Harsch.

ALBERGA, ALVYN CLYDE, Florence, Ala. (Age 28.) Eng. Aide (Transitman and Computer), Dept. of Electricity, TVA. Refers to H. M. Clute, F. H. Conley, W. R. Dunn, P. B. Hill, F. W. Truss, G. D. Whitmore.

ANDERSON, ARVAL LLOYD, Washington, D.C. (Age 33.) Engr., U. S. Forest Service. Refers to M. B. Arthur, I. C. Crawford, J. C. Dort, R. S. Henderson, E. W. Kramer, R. W. Lincoln, J. P. Martin, T. W. Norcross.

BANDY, WILLIAM ROY, Helena, Mont. (Age 51.) With U.S. General Land Office as U. S. Cadastral Engr. in Montana, Wyoming, New Mexico, and Nebraska. Refers to C. S. Heidel, P. L. Inch, F. M. Johnson, A. D. Kidder, W. A. Lamb, W. H. Richards, Jr., C. G. Tudor.

BERNSTEIN, JOSEPH JOHN, Eastport, Maine. (Age 29.) Associate Engr., U. S. Engrs. Refers to H. L. Cook, B. C. Dunn, F. P. Fifer, H. H. Hatch, F. J. Nebiker.

BERWICK, WILLIAM EVANS, Brightwaters, N.Y. (Age 35.) Asst. Gen. Supt., Long Island State Park Comm., Babylon, N.Y. Refers to J. M. Belknap, H. Five, J. Forgie, C. E. Fraser, A. E. Howland, S. Shapiro.

BOOKER, JAMES LESTER, JR., Little Rock, Ark. (Age 30.) Tech. Engr., State Engr.'s Office (PWA). Refers to W. E. Ford, G. L. Fry, R. C. Gibson, W. H. Marak, J. M. Page, W. W. Zass.

BROWN, DWIGHT, Arcadia, Fla. (Age 34.) Project Engr., State Road Dept. of Florida. Refers to J. H. Dowling, W. A. Hadley, B. P. McWhorter, J. A. Riviere, J. R. Slade, C. W. Wright.

CHELAZZI, PAUL CAESAR, Shanghai, China. (Age 31.) Head of his own firm, Cons. Civ. and Structural Engrs., Archts., Surveyors and Land and Estate Agents. Refers to H. F. Barnes, U. F. Beichmann, H. Berents, J. A. Ely, C. N. Joyner.

CHERRY, JAMES LINTON, Philadelphia, Pa. (Age 31.) Associate with H. A. Kuljian & Co., Cons. Engrs. Refers to L. E. Cambios, F. L. Castleman, C. L. Harris, B. Lafferty, R. L. Sackett.

CHURCH, JOSHUA PRICE, Deming, N.Mex. (Age 41.) Dist. Engr. (Dist. Highway Engr.), New Mexico State Highway Dept. Refers to L. R. Allison, G. F. Conroy, B. G. Dwyre, F. G. Healy, T. M. McClure, G. D. Macy, A. O. Peabody, L. C. Rockett.

COCKEY, JOHN DAVIDSON, Claiborne, Md. (Age 38.) Prin. Engr., Inspector Supt., U.S. Bureau of Public Roads, Roanoke, Va. Refers to C. M. Africa, W. M. Austin, H. K. Bishop, O. L. Brodie, E. G. Middleton, H. J. Spelman, G. S. Ward.

COFFEY, PHILIP JOHN, Boston, Mass. (Age 25.) Computer, Local Control Survey of Massachusetts (WPA). Refers to J. B. Babcock, 3rd, T. R. Camp, J. W. Howard, G. E. Russell, C. M. Spofford.

COWAN, MERTON ROBERT, Rochester, Minn. (Age 23.) Refers to J. W. Howe, R. B. Kittredge, B. J. Lambert.

DILLS, CHARLES CLINTON, Lawrence, Kans. (Age 28.) Asst. State Director, Community Sanitation Project (WPA), U. S. Public Health Service, Topeka, Kans. Refers to W. B. Baldry, E. Boyce, D. D. Haines, J. O. Jones, R. E. Lawrence, W. C. McNown, R. J. Paulette, F. A. Russell, F. M. Veatch.

DRUHOT, GEORGE STANLEY, Sacramento, Calif. (Age 40.) Associate Topographic Engr., U.S. Geological Survey. Refers to L. L. Bryan, W. R. Chenoweth, H. H. Hodgeson, R. R. Monbeck, C. N. Mortenson, J. G. Staack.

ENGLER, LESLIE WINFRED, New York City. (Age 27.) Tutor, Civ. Eng. Dept., Coll. of City of New York. Refers to W. Allan, R. E. Goodwin, F. O. X. McLoughlin, J. S. Peck, W. L. Willig.

ESTES, FRANKLIN EDWARD, Albuquerque, N. Mex. (Age 58.) Project Engr., New Mexico Highway Dept.; Dist. Superv. Engr., CWA and ERA of New Mexico. Refers to D. H. Barber, J. H. Dorroh, B. G. Dwyre, J. N. Gladding, L. E. Lyon, T. M. McClure, G. M. Neel, G. C. Street, Jr.

EWING, WESLEY CHARLES, San Francisco, Calif. (Age 25.) Refers to C. Derleth, Jr., B. A. Etcheverry.

FARQUHARSON, FREDERICK BURT, Seattle, Wash. (Age 40.) Asst. Prof. of Civ. Eng., Univ. of Washington. Refers to C. W. Harris, J. Kylstra, G. E. Large, C. C. May, C. C. More, R. G. Tyler.

FISCHER, ANTHONY JOSEPH, New York City. (Age 34.) San. Development Engr., The Dorr Co., Inc. Refers to R. A. Allton, F. Bachmann, L. H. Enslow, G. B. Gascoigne, H. H. Hendon, C. G. Hyde, W. Rudolfs.

FRISTOE, ROBERT EDWIN, Galveston, Tex. (Age 44.) Chf. Engr., Galveston Wharf Co. Refers to E. C. H. Bantel, G. G. Edwards, K. E. Kirby, J. L. Starkie, J. Vawter, C. C. Washington, G. G. Wickline.

GAYLORD, EDWIN HENRY, JR., Athens, Ohio. (Age 33.) Asst. Prof., Dept. of Civ. Eng., Ohio Univ. Refers to C. G. Conley, L. M. Gram, J. D. K. Lyman, F. H. Neff, F. L. Plummer, H. C. Plummer.

GOODWIN, JAMES WILLIAM, Birmingham, Ala. (Age 31.) J. W. Goodwin Eng. Co., Cons. Engrs. on PWA projects. Refers to J. A. C. Callan, H. A. Davies, A. C. Decker, A. B. Dunning, H. H. Hendon.

HAMMOND, GEORGE WARREN, Freehold, N.J. (Age 22.) Transitman, Suburban Homesteads, Hightstown (N.J.) Project. Refers to A. Atkinson, H. N. Lendall.

HARRISON, SHANNON, Dallas, Tex. (Age 32.) Party Chf., Civ. Eng. Dept., Shell Petroleum Corporation, Houston, Texas. Refers to W. M. Eliot, J. A. Focht, W. J. Fuston, R. B. Pratt, T. U. Taylor.

HARTLINE, WALDO, Dover, Ohio. (Age 40.) Arnold, Rosch & Hartline, Civ., Mining and Structural Engrs., New Philadelphia, Ohio. Refers to W. P. Brown, J. W. Bulger, J. S. Gena, A. E. Kimberly, C. T. Morris, J. R. Smart, F. H. Waring.

HIZON Y OCHOA, ANDRES, Washington, D.C. (Age 30.) Graduate student, Cornell Univ., as Philippine Govt. Scholar, Dept. of Public Works and Communications, Manila, P.I. Refers to H. G. Avers, F. A. Barnes, S. C.

Hollister, R. R. Lukens, F. J. Spry, P. H. Underwood.

JOHNSON, CHARLES ALBIN, JR., Centerport, N.Y. (Age 28.) Marine Draftsman, Navy Dept., Brooklyn, N.Y. Refers to H. E. Breed, C. T. Schwarze.

LA FOLLETTE, ROBERT MEREDITH, Ames, Iowa. (Age 29.) Project Coordinator, Procurement Office, National Park Service. Refers to F. A. Belousek, C. H. Currie, H. R. Green, C. A. Haskins, M. L. Hutton, R. O. Ruble.

LA VALLEY, EDWARD CLOVIS, Bronx, N.Y. (Age 32.) Instructor, Coll. of Eng., New York Univ. Refers to L. V. Carpenter, A. Haring, T. Saville, C. T. Schwarze, D. S. Trowbridge, S. F. Yasines.

MCCRONE, JOHN ROY, JR., Havre de Grace, Md. (Age 32.) Cons. Engr. and Gen. Contr. Refers to J. G. Barry, C. B. Bryant, A. F. Di Domenico, J. B. Jenkins, R. Mather, S. J. Raymond, R. M. Reindollar.

MCLEAN, WILLIAM BISSEL, Bethlehem, Pa. (Age 28.) Designer, Fabricated Steel Constr., Bethlehem Steel Co. Refers to E. F. Ball, E. L. Durkee, W. H. Jameson, J. Jones, P. J. Quimby.

MINSHALL, NEAL EDWARD, La Crosse, Wis. (Age 36.) Eng. Supervisor of ECW Camps, Soil Conservation Service. Refers to F. M. Dawson, D. W. Mead, H. W. Mead, C. V. Seastone, L. C. Tschudy, C. N. Ward, E. N. Whitney.

MORIN, JOHN ABNER, Berkeley, Calif. (Age 31.) Draftsman and Inspector, Joint Highway Dist. No. 13. Refers to C. E. Beugler, C. H. Boardman, W. B. Boggs, P. K. Davis, A. S. Gelston.

OLSEN, BRUCE CHARLES, Seattle, Wash. (Age 22.) Refers to C. C. More, F. H. Rhodes, Jr., R. G. Tyler.

PALMORE, HOVEY DUNCAN, Frankfort, Ky. (Age 30.) Pres. and Gen. Mgr., Kentucky Concrete Pipe Co., Inc. Refers to H. R. Creal, J. F. Grimes, C. W. Lovell, G. H. Sager, Jr., D. V. Terrell, J. S. Watkins.

PARK, KENNETH FOOTE, Peoria, Ill. (Age 44.) Engr. with R. G. Le Tourneau, Inc. Refers to R. P. Bryan, J. F. Johannsen, R. Matthew, F. H. Tibbetts, R. G. Wadsworth, H. I. Wood.

PARKER, WALTER HUNTINGTON, Minneapolis, Minn. (Age 51.) Prof. and Head of Dept. of Mining, also member of faculty of Graduate School, School of Mines and Metallurgy, Univ. of Minnesota. Refers to F. Bass, J. Cowin, A. S. Cutler, G. M. Garen, W. R. Goodwin, F. Hutchinson, A. F. Johnson, O. M. Leland, L. G. Straub, W. H. Wheeler.

PETERSON, JAMES EDWARD, Batavia, Ill. (Age 23.) Asst. Engr., Conservation Bureau, Research Laboratory, Portland Cement Association. Refers to J. G. Bennett, T. L. Condron, H. F. Gonnerman.

PHILIPPE, ROBERT RENE, Zanesville, Ohio. (Age 29.) Associate Engr., U. S. Engr. Office. Refers to A. L. Alin, W. Gerig, G. Gilboy, L. C. Hill, J. D. Justin, T. T. Knappen, B. M. Moore.

PINKERTON, RICHARD DAVID, Santa Ana, Calif. (Age 21.) Instrumentman, Pacific Elec. Ry. Co., Los Angeles, Calif. Refers to B. A. Etcheverry, S. T. Harding.

REAGAN, CODY SYLVESTER, Dallas, Tex. (Age 47.) Refers to H. W. English, T. C. Forrest, Jr., C. Manes, E. L. Myers, E. N. Noyes, W. J. Powell, R. E. Thomas.

RIDDET, JOHN ORMOND, Arima, Trinidad, British West Indies. (Age 48.) Res. Engr., Trinidad Central Water Scheme, Trinidad Govt. and Howard Humphreys & Sons. Refers to E. C. Buck, H. C. L. Humphreys, M. R. Keefe, H. V. Spurr. (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

RIDER, JAMES VAULX, Lincoln, Nebr. (Age 25.) Structural Detailer and Designer, Lincoln Steel Works. Refers to M. I. Evinger, H. J. Kemer, J. G. Mason, C. E. Mickey, A. L. Ogle.

ROBERTS, CHARLES PRESSLEY, Marion, S.C. (Age 48.) Johnson & Roberts, Engrs. Refers to E. D. Clement, F. H. Cothran, J. M. Johnson, L. W. Pollard, J. E. Sirrine, J. E. Willoughby.

ROTH, ARTHUR THEODORE, Indiana, Pa. (Age 25.) Jun. Agricultural Engr., U. S. Dept. of Agriculture, Soil Conservation Service. Refers to F. J. Hanrahan, E. D. Walker.

RYAN, WILLIAM JEROME, Wharton, N.J. (Age 43.) Field Engr. and Draftsman on CWA, CCC, and PWA projects, surveys, maps, etc. Refers to A. M. Brosius, E. H. Feldmann, G. W. Gardner, F. J. Laverty, C. J. Suhr, A. M. Wyman.

SCHAPIRO, KOPPEL, Columbus, Nebr. (Age 35.) Designer, Harza Eng. Co. Refers to H. A. Beckwith, W. L. Fulton, H. J. Hansen, L. F. Harza, J. H. Heald, C. H. James.

SCHLESINGER-CARRERA, LUIS ANTONIO MIGUEL, Guatemala City, Guatemala. (Age 38.) Cons. Engr. and Contr. Refers to J. E. Alcaine, Jr., A. A. Bickford, A. S. Hadley, M. E. Lopez Harrison, A. A. Martinez, S. Vilar y Boy, L. F. Whitbeck.

SCHOOLEY, FLOYD WAYNE, Los Angeles, Calif. (Age 37.) In charge of Los Angeles Office Chicago Bridge & Iron Works. Refers to L. A. Elsener, A. H. Fuller, G. T. Horton, F. W. Karge, R. J. Reed.

SCHRADER, FLOYD FRANKLIN, Charlottesville, Va. (Age 34.) Associate Engr., U. S. Geological Survey, Water Resources Branch. Refers to J. A. Anderson, N. C. Grover, H. F. Hill, A. H. Horton, J. C. Hoyt, C. G. Paulsen, S. S. Steinberg.

SCHRONTZ, CHALMERS CLINTON, Jacksonville, Fla. (Age 61.) Asst. to Engr. in Charge, Caloosahatchee River and Lake Okeechobee Drainage Project, U. S. Dist. Engr.'s Office. Refers to G. M. Bull, R. Follansbee, G. B. Hills, M. C. Hinderlider, G. A. Youngberg.

SERRA-ZANETTI, UGO, New York City. (Age 45.) Designer, U. S. Navy Yard, Brooklyn, N.Y. Refers to R. W. Boyd, T. W. Marshall, H. C. Paddock, J. P. H. Perry, M. S. Rich.

SHAVER, ROBERT EZEKIEL, Lexington, Ky. (Age 30.) Asst. Prof. of Civ. Eng., Univ. of Kentucky. Refers to W. J. Carrel, J. F. Grimes, C. W. Lovell, H. L. Shearer, D. V. Terrell, J. S. Watkins.

STEVENSON, ROBERT GRAY, Sacramento, Calif. (Age 36.) Associate Engr., U. S. Geological Survey. Refers to C. H. Birdseye, L. L. Bryan, W. R. Chenoweth, H. H. Hodgeson, R. R. Monbeck, C. N. Mortenson, J. G. Staack.

THADANI, NEBHRAJ METHARAM, Mahoba (U.P.) India. (Age 32.) Res. Engr., Great Indian Peninsula Ry. Refers to A. N. Khosla, K. Singh. (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

THOMAS, MELVIN CLAY, Decatur, Ala. (Age 32.) Unit Chf., TVA, Eng. Service Div. Refers to R. E. Frierson, H. J. Kelly, R. L. Moore, N. H. Sayford, F. W. Truss, G. D. Whitmore, H. A. Wiersema.

THOMPSON, GEORGE AITON, Woodhaven, N.Y. (Age 34.) Designer, Engr., New York Terminal Dist., New York Central R.R. Co., New York City. Refers to P. M. Corry, M. Ketchum, J. E. Porter, Z. H. Sikes, W. F. Steffens.

THURINO, ADOLPH CARL, Ft. Peck, Mont. (Age 30.) Jun. Engr., U. S. Engr. Dept., being Office Asst. to Asst. Chf. of Operation. Refers to A. Boyd, E. F. Chandler, P. A. Harper, T. B. Larkin, E. G. Plank, J. R. Thatcher.

TOMPKINS, FRANCIS MEADE, Washington, D.C. (Age 27.) Gen. Supt., Chas. H. Tompkins Co. Refers to J. B. Alexander, F. F. Gillen, C. W. Humphreys, H. H. Marsh, A. W. Parker, G. B. Strickler, H. C. Whitehurst, C. R. Whyte.

UPTON, WILLIAM BAYLY, JR., Sacramento, Calif. (Age 43.) Associate Topographical Engr., U. S. Geological Survey. Refers to C. H. Birdseye, W. R. Chenoweth, H. H. Hodgeson, R. R. Monbeck, C. N. Mortenson, J. G. Staack.

WADDELL, FREDERICK CREELMAN, East Orange, N.J. (Age 60.) Superv. Engr., New Jersey State Local Control Survey. Refers to P. Kissam, E. Pendlebury, G. E. J. Pistor, C. E. Smith, G. E. Tilt, C. E. Trout.

WHITE, JOSEPH HENRY, Coraopolis, Pa. (Age 51.) With Board of Allegheny County Commrs., Pittsburgh, Pa. Refers to N. F. Brown, N. B. Jacobs, P. W. Price, C. M. Reppert, J. M. Rice, M. R. Scharff.

WILSON, VERNE GEORGE, Ames, Iowa. (Age 22.) Draftsman, Bridge Dept., Iowa Highway Comm. Refers to R. A. Caughey, F. Kerekes, R. A. Moyer.

WILTSIE, RALPH MILAN, Princeton, Ind. (Age 25.) Jun. Tech. Foreman (Engr.), Soil Conservation Service, U. S. Dept. of Agriculture. Refers to G. E. Lommel, R. B. Wiley.

WITTWER, NORMAN CARL, Rahway, N.J. (Age 41.) Res. Engr., Inspector, FEA of PW, Washington, D.C. Refers to W. C. Cattell, F. C. Claus, H. T. Critchlow, H. M. Freeburn, W. A. Goff, H. N. Lendall, E. H. Maier, H. J. Sherman, B. A. Sleeper, J. A. Williams.

ZOLLWEG, HERBERT AUGUSTUS, Rochester, N.Y. (Age 37.) Computer, Eng. Dept., City of Rochester. Refers to P. A. Covas, E. A. Fisher, M. D. Hayes, W. H. Roberts, J. F. Skinner, A. L. Vedder, E. H. Walker.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

BERGMAN, ELMER OTTO, Assoc. M., Boulder, Colo. (Elected Oct. 14, 1929.) (Age 44.) Associate Prof. of Civ. Eng., Univ. of Colorado. Refers to L. F. Copeland, F. W. Dencer, C. L. Eckel. H. J. Gilkey, I. E. Houk, W. C. Huntington.

DORT, JOSEPH CUMMINGS, Assoc. M., Washington, D.C. (Elected Nov. 3, 1915.) (Age 50.) Asst. Regional Forester, Div. of Eng., U. S. Forest Service. Refers to C. A. Betts, H. K. Bishop, F. H. Fowler, N. C. Grover, W. L. Huber, H. S. Jacoby, E. W. Kramer, T. W. Norcross, V. M. Peirce.

DRESSER, GEORGE LUCAS, Assoc. M., Albany, N.Y. (Elected Oct. 9, 1917.) (Age 50.) Bridge Engr. and Eastern Railroad Representative, Jennison-Wright Co., Toledo, Ohio; Vice-Pres., and Treas., The Standard Eng. Corporation, Contr. Engrs., Albany, N.Y.; Pres., The Werts Co., Cleveland, Ohio. Refers to R. E. Dougherty, F. O. Dufour, D. A. Keefe, G. A. Noren, G. J. Ray, H. T. Welty, E. W. Wendell.

DWYRE, BURTON GOLDING, Assoc. M., Santa Fe, N.Mex. (Elected Junior Oct. 21, 1924; Assoc. M. May 12, 1930.) (Age 35.) Asst. State Highway Engr., New Mexico State Highway Dept.; also U. S. Mineral Surveyor, District of New Mexico. Refers to G. F. Conroy, G. D. Macy, G. M. Neel, A. O. Peabody, L. C. Rockett.

FENNER, JOHN SHERROD, Assoc. M., Beeville, Tex. (Elected April 3, 1922.) (Age 51.) County Engr., Bee County, Tex. Refers to E. P. Arneson, T. W. Bailey, C. T. Bartlett, G. G. Edwards, G. Gilchrist, A. P. Rollins, G. G. Wickline.

FLOYD, RICHARD ARCHIBALD, Assoc. M., Santa Paula, Calif. (Elected March 15, 1926.) (Age 44.) Chf. Engr., ECW, U. S. Soil Conservation Service. Refers to T. J. Allen, R. S. Carberry, W. H. Code, H. W. Jorgensen, E. C. Kanters, C. W. Petit, R. R. Rowe.

JARVIS, WALTER MONROE, Assoc. M., London, Ky. (Elected Junior Aug. 31, 1925; Assoc. M., March 14, 1927.) (Age 40.) Dist. Supervisor, Div. of Projects and Planning, WPA. Refers to C. W. Lovell, J. T. Madison, M. D. Ross, D. V. Terrell, E. N. Todd, J. S. Watkins.

KING, HOWARD LANGDON, Assoc. M., New York

City. (Elected Junior April 17, 1917; Assoc. M., Nov. 9, 1920.) (Age 46.) Chf. Engr., Mason & Hanger Co., Inc. Refers to C. S. Gleim, W. M. Griffin, M. I. Killmer, O. Singstad, R. Smillie.

KOHLER, MERVIN HOWARD, Assoc. M., Philadelphia, Pa. (Elected June 9, 1930.) (Age 43.) Asst. Engr., Bureau of Eng., Surveys and Zoning. Refers to T. Buckley, A. S. Craven, A. Z. Hoffman, J. H. Neeson, E. R. Schofield.

MORGAN, CHARLES EDWARD, Assoc. M., Springfield, Ill. (Elected Feb. 10, 1930.) (Age 44.) Asst. Highway Engr., Bureau of Bridges. Refers to G. F. Burch, E. D. Dryfoose, H. E. Eckles, C. M. Hathaway, E. Lieberman, L. E. Philbrook, W. N. Schroeder, L. T. Wyly.

OSGOOD, WILLIAM R., Assoc. M., Washington, D.C. (Elected Oct. 12, 1925.) (Age 40.) Materials Testing Engr., National Bureau of Standards. Refers to H. Cross, M. L. Enger, C. C. Fishburn, D. E. Parsons, H. M. Westergaard, W. M. Wilson, C. A. Wright.

WRIGHT, THOMAS JUDSON, JR., Assoc. M., Norfolk, Va. (Elected Junior June 1, 1909; Assoc. M., Sept. 3, 1912.) (Age 49.) Mgr., Richmond Cedar Works and Dismal Swamp R.R. Co. Refers to F. H. Cothran, J. E. Crawford, W. D. Faucette, W. T. Howe, F. L. Nicholson, W. H. Taylor, 3d, W. P. Wiltsee.

FROM THE GRADE OF JUNIOR

BUCHANAN, SPENCER JENNINGS, Jun., Vicksburg, Miss. (Elected Nov. 15, 1926.) (Age 32.) Associate Engr., U. S. Waterways Experiment Station; also Consultant for U. S. Engr. Corps at Large. Refers to E. P. Arneson, E. A. Dockstader, H. Kramer, G. H. Matthes, J. J. Richey, C. M. Spofford, L. White.

CLOOS, GEORGE PHILLIP, Jun., Woodhaven, N.Y. (Elected July 11, 1927.) (Age 32.) Computer, Geophysical Service, Inc., Cons. Geophysicists, Dallas, Tex. Refers to B. F. Biemann, A. Haring, J. J. Loeser, C. T. Schwarze, D. S. Trowbridge.

DURR, CHARLES EUGENE, JR., Jun., New York City. (Elected Oct. 26, 1931.) (Age 29.) Senior Engr., New York State Dept. of Labor, Unification of Building Codes. Refers to L. J. Ehrhart, H. Eichin, A. Haring, C. T. Schwarze, D. S. Trowbridge, S. F. Yasines.

ETTINGER, LOUIS JOSEPH, JR., Jun., Skaneateles, N.Y. (Elected July 31, 1933.) (Age 29.) Chf. Engr., Eastern Road Dept., International Salt Co. Refers to G. A. Helmstetter, C. A. Hogentogler, L. Mitchell, S. D. Sarason, J. R. Taft.

GRANACHER, CHARLES WILLARD, Jun., Gallipolis, Ohio. (Elected Oct. 14, 1929.) (Age 28.) With Dravo Contr. Co. as Field Engr., Gallipolis Dam. Refers to G. H. Atwood, A. W. Dann, R. J. Fogg, C. B. Jansen, H. G. Payrow, J. H. C. Sprague.

HAZARD, STUART GRAY, Jun., Topeka, Kans. (Elected Dec. 3, 1928.) (Age 29.) Cons. Engr. (associated with R. A. Finney). Refers to E. Boyce, O. J. Eidmann, F. W. Epps, W. C. McNown, J. Singleton, L. B. Smith, E. M. Spencer.

HOBART, THOMAS FITZHUGH, Jun., Carrollton, Ala. (Elected July 16, 1928.) (Age 30.) Res. Engr., Alabama State Highway Dept. Refers to C. A. Baughman, J. A. C. Callan, W. H. Caruthers, L. Gottlieb, R. D. Jordan, F. A. Salmon, Sr., J. E. Willoughby.

MASON, MORRIS, Jun., Wood River, Ill. (Elected Dec. 3, 1928.) (Age 33.) With Standard Oil Co. (Indiana). Refers to N. Enger, W. C. Huntington, F. E. Richart, V. W. Russell, W. R. Spencer, W. M. Wilson, W. R. Young.

NETTLETON, DOUGLAS ARTHUR, Jun., East Orange, N.J. (Elected Oct. 1, 1926.) (Age 32.) Designer, Port of New York Authority. Refers to O. H. Ammann, A. P. Andersen, A. Dana, C. W. Dunham, G. M. Rapp, R. F. Schaefer, R. Smillie.

NOBES, HERBERT ERIC, Jun., Bronx, N.Y. (Elected Oct. 14, 1929.) (Age 31.) Valuation Engr., North-Eastern Constr. Co., New York City. Refers to L. H. Davis, H. W. Ferris, J. K. Finch, C. S. Howell, O. M. Jones, W. J. Krefeld, F. X. Scanlan.

PARKER, JACOB SILAS, JR., Jun., Elizabeth, N.J. (Elected Feb. 10, 1930.) (Age 32.) Res. Engr., Fuller & McClintock, New York City, on Rahway Valley Joint Meeting (N.J.) Sewage-Treatment Plant. Refers to F. G. Cunningham, W. Donaldson, C. A. Emerson, Jr., H. K. Gatley, E. G. Manahan, A. E. O'Reilly, F. B. Shinn.

PROFFITT, GORDON HARRISON, Jun., Portland, Ore. (Elected Oct. 14, 1929.) (Age 28.) Special Agent, Engr. Grade, Div. of Investigations, PWA. Refers to H. K. Boone, C. Derleth, Jr., G. W. Howson, J. R. Johnston, F. E. Trask, J. B. Warrack, J. W. Williams.

SAMPSON, RAPHAEL, Jun., San Francisco, Calif. (Elected Nov. 10, 1930.) (Age 30.) Associate Bridge Designing Engr., San Francisco-Oakland Bay Bridge. Refers to C. E. Andrew, H. J. Brunnier, N. C. Raab, C. E. Seage, H. F. Topping, H. C. Wood, G. B. Woodruff.

SCHROEPFER, GEORGE JOHN, Jun., Minneapolis, Minn. (Elected Feb. 10, 1930.) (Age 29.) Asst. Chf. Engr., Minneapolis-St. Paul San. Dist., on Minneapolis-St. Paul Sewage-Disposal Project. Refers to F. Bass, W. N. Carey, A. S. Cutler, A. J. Duvall, H. M. Hill, C. W. Kutz, A. F. Meyer, G. M. Shepard.

SOWLES, LAWRENCE PINKERTON, Jun., Berkeley, Calif. (Elected Oct. 1, 1926.) (Age 33.) Engr., Utah-Bechtel-Morrison-Kaiser Co. and Frederickson & Watson Constr. Co., Contrs. for Taylor Park Dam, Almont, Colo. Refers to A. H. Ayers, F. T. Crowe, R. B. Davis, C. Derleth, Jr., D. B. Gumensky, G. Havas, C. G. Hyde, M. B. McGowan, Jr., J. Shaw, C. W. Sopp, N. Werner, J. P. Yates.

STUNKARD, CLARENCE RUSSELL, Jun., Seattle, Wash. (Elected Oct. 14, 1930.) (Age 32.) Engr., King County, Dist. No. 2, Wash. Refers to T. H. Carver, I. L. Collier, J. A. Fallgreen, R. H. Thomson, R. G. Tyler, R. B. Van Horn.

WARLOW, EARNEST JUDSON, Jun., Washington, D.C. (Elected Jan. 13, 1930.) (Age 28.) Asst. Structural Engr., Procurement Div., Treasury Dept., U. S. Govt. Refers to J. W. Dunham, J. H. Eaton, R. J. Fogg, P. J. Hale, W. Kaufholz.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1935 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

EXECUTIVE

HYDRAULIC AND STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; age 33; married; graduate; 12 years experience on investigation, surveys, design, estimate, construction, and maintenance of large and small hydro-electric developments, domestic and foreign. Desires connection with power company. Available on reasonable notice. C-3752.

PROMOTION AND CONSTRUCTION; Assoc. M. Am. Soc. C.E.; New York state license; graduate of Rensselaer Polytechnic Institute; married; 45; 13 years, construction foreman, industrial design, and field engineer; 12 years, fire-protection, trade extension, building-code and legislation expert, consultant and executive manager. Competent speaker; versatile; good address; seeks responsible position with New York headquarters on difficult, productive work. B-3727.

GRADUATE SANITARY ENGINEER; Jun. Am. Soc. C.E.; registered in Pennsylvania; 8 years experience in design and operation of sewage treatment and water purification plants, design and construction of sewers, investigations and reports, river hydraulics, and general municipal engineering. Available on short notice. C-7884.

CONSULTING ENGINEER; M. Am. Soc. C.E.; Mem. A.I.E.E.; 60; single; graduate Stanford University; 6 years superintendent and chief engineer hydro-electric transmission and city distribution system; 30 years experience consulting engineer. Among clients: U. S. Department of the Interior, state of California, many municipalities, and corporations specializing in power and transmission systems, dams, and irrigation. D-4229-358-A-1 San Francisco.

GRADUATE SANITARY ENGINEER; Assoc. M. Am. Soc. C.E.; licensed professional engineer; 10 years in design and construction of sewage treatment works and sewers; 1 year as superintendent of construction; 2 years in manufacturing and promoting concrete pipe; 1 year in selling mechanical equipment for sewage treatment plants; at present employed. Desires connection where all-around experience is essential. C-874.

CIVIL ENGINEER; M. Am. Soc. C.E.; age 41; now available; civil engineering graduate, Massachusetts Institute of Technology; 11 years experience as foreman, superintendent, construction engineer on sewers, tunnels, subways, harbor work, earthwork, surveys; 3 years stadia; some knowledge steam and refrigeration. D-4227.

MANAGING ENGINEER; M. Am. Soc. C.E.; Pennsylvania state registration; over 20 years in steel fabrication engineering, sales and field and shop activities; also in general construction business. Desires opportunity of making a new connection. C-5095.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22½; single; C.E., Rensselaer Polytechnic Institute, 1935; Sigma Xi; now temporarily employed by the New York Park Department (under WPA) as transitman on park layout and building construction. Desires opportunity in any branch of civil engineering; prefers design or construction. Location immaterial. D-4587.